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THE PALAEONTOLOGY AND STRATIGRAPHY OF THE SILURO-DEVONIAN SEDIMENTS OF THE TYERS AREA, GIPPSLAND, VICTORIA

By G. M. Philip

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Abstract

A discussion of the structure, stratigraphical subdivisions, lithologies and fauna of the Siluro-Devonian sediments of the Tyers area is given. Two new stratigraphical subdivisions are proposed, the 'Boola Beds' for the stratigraphical equivalents of the Tanjil Beds in this area, and the 'Coopers Creek Formation' to replace the 'Basal Conglomerates and Limestones of the Walhalla Beds'. 28 tabulate coral species, 33 rugose coral species, subspecies and varieties, 26 brachiopod species, 6 lamellibranch species and 4 trilobite species, are described. These (together with 19 stromatoporoid species not described here) represent the more common invertebrate species of the fauna. Their distribution through 57 fossil localities is noted. New taxonomic categories proposed are the tabulate corals *Favosites hillae* sp. nov., *F. coactilis* sp. nov., *F. macilentus* sp. nov., *Natalophyllum callidum* sp. nov., *Fossopora quintaria* sp. nov.; the rugose corals *Syringaxon* (*Saucrophyllum*) *poecillum* subgen. et sp. nov., *Pseudamplexus princeps* (Etheridge) var. *confertus* var. nov., *Disphyllum cognatum* sp. nov., *D. incongruum* sp. nov., *Tipheophyllum ops* sp. nov., *Tabulophyllum meridionale* sp. nov., *Dohmophyllum pridianum* sp. nov., *Lyrielasma subcaespitosum praecursor* subsp. nov., *Tryplasma etheridgei* sp. nov.; the brachiopods *Dolerorthis persculpta* sp. nov., *Onniella tyersensis* sp. nov., *Tyersella typica* gen. et sp. nov., *Resserella impensa* sp. nov., *Isorthis festiva* sp. nov., *Strophonella gippslandica* sp. nov., *Plectatrypa australis* sp nov., *Lissatrypa lenticulata* sp. nov., *Delthyris* (*Howellella*) *scabra* sp. nov.; the lamellibranch *Ctenodonta* (*Praectenodonta*) *raricostae* (Chapman) subgen. nov.; the trilobite *Leonaspis bispinosa* sp. nov.

Introduction

In common with most of the Silurian and Devonian sediments of the Walhalla Synclinorium, the area around the lower Tyers R. has received very little attention, so that the faunas are virtually unknown. As early as 1907, Chapman (p. 70) stated of some specimens of limestone collected from the limestones outcropping along the Tyers R.—'They are rich in crinoid and coral remains, and the particular bed from which they were taken promises eventually to be a veritable storehouse of Silurian fossils'. Chapman's prediction was well founded. The present paper deals with the description of 97 of the more common invertebrate species (apart from the stromatoporoids) from this and the underlying horizons. In all it is estimated that over 200 invertebrate species are represented in the fauna.

When this work was started in 1955, it was intended to map and study the faunas of all the limestone horizons of the Walhalla Synclinorium. However the Tyers area, to the extreme S. of the main outcrop belt of these Palaeozoic rocks, proved so richly fossiliferous that the original plan was abandoned and this area was studied in detail. The present paper should provide a basis for the description of the rest of the faunas of the Walhalla Synclinorium at this stratigraphic level.

The area investigated is approximately 2 m. by 1½ m. and is situated about 5 m. NW. of the township of Tyers, about 70 m. E. of Melbourne. To the N. and E. of this area the Palaeozoic rocks are obscured by Tertiary basalts and sediments capping the Boola spur, which carries the main Tyers-Erica road, while to the S. they disappear beneath the Jurassic rocks of the Tyers Group. The W. boundary of the area is marked by the virtually unfossiliferous Walhalla Beds. Most of the area lies within the Parish of Boola Boola, but that portion W. of the Tyers R. is in the Parish of Tanjil East. National Grid Co-ordinates are shown on the map (Fig. 1). As with most of the outcrop area of the Palaeozoic rocks of this region, the country is rough and heavily timbered. Exposures in the area are poor apart from quarries, road cuttings and river sections. Thus, as the area did not lend itself to accurate geological mapping, many of the boundaries shown in the geological map are inferred.

In all, several thousand specimens were collected from 57 fossil localities in the area. In the study of the fauna of the limestones of the order of 2000 thin sections were prepared. The collection is housed in the Melbourne University Geology Department where most of the work was undertaken. The final draft of portions of the manuscript was prepared during the tenure of a Commonwealth Scientific and Industrial Research Organization Overseas Studentship, at the Sedgwick Museum, Cambridge.

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Previous Investigation

Murray (1876) was the first to mention the occurrence of limestones outcropping in the area investigated. He states (p. 40)—'In the Tyers River are very hard schists and silicious sandstones, and in a small tributary east of the river is a band of dark-grey limestone, with indistinct fossil markings and corals . . .'. In 1887 (p. 44) he again remarked on the occurrence of limestone along the Tyers R. and (p. 15) listed its age as Upper Silurian, this apparently being based on comparison between it and the limestones at Coopers Creek, which McCoy had suggested were Upper Silurian on 'very imperfect palaeontological grounds'. Murray (1889) again gave a more detailed account of the limestone occurrences.

Chapman (1907) has been the only author to identify any fossils from the

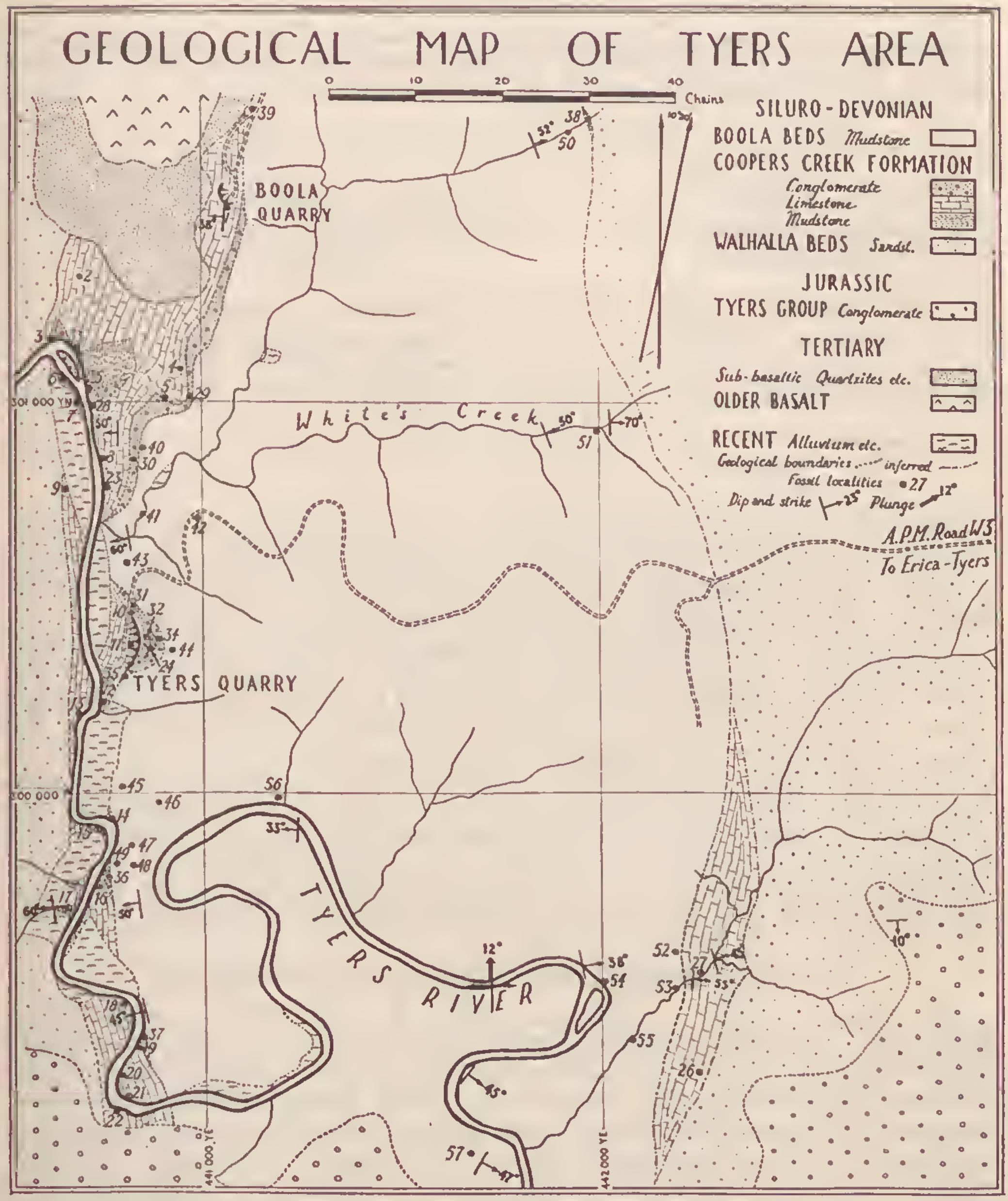
GEOLOGICAL MAP OF TYERS AREA
0 10 20 30 40 Chains
SILURO-DEVONIAN
BOOLA BEDS Mudstone
COOPERS CREEK FORMATION
Conglomerate
Limestone
Mudstone
WALHALLA BEDS Sandst.
JURASSIC
TYERS GROUP Conglomerate
TERTIARY
Sub-basaltic Quartzites etc.
OLDER BASALT
RECENT Alluvium etc.
Geological boundaries inferred
Fossil localities •27
Dip and strike 25
Plunge 12°
A.P.M. Road W3
To Erica-Tyers
BOOLA QUARRY
TYERS QUARRY
White's Creek
TYERS RIVER
301 000 YN
300 000
441 000 YE
442 000 YE

Fig. 1.

area. Shown below are Chapman's determinations, as interpreted in this paper. It is unfortunate that Chapman's specimens could not be found, either in the Geological Survey Museum or in the National Museum, Melbourne, and so the forms have been interpreted from Chapman's figures and descriptions.

Chapman 1907	Here identified
Girvanella conferta sp.nov.	*G. conferta* Chapman
G. cf. *incrustans* (Wethered)	*G.* cf. *incrustans* (Wethered)
G. (?) *pisalitica* (Wethered)	*G.* (?) *pisalitica* (Wethered)
Manatrypa sp.	?
Favosites gathlandica Lamarck	*F. gothlandicus* Lamarck
Cannapara australis sp.nov.	*Favosites squamuliferus* forma *australis* (*fide* Philip 1960a)
Rhombapara gippslandica sp.nov.	*Caenites* (*Cladopara*) *gippslandica* (Chapman)
? *Palaeechinus*	?

Chapman suggested that certain of the rocks he examined from Tyers were 'from a volcanic tuff, more or less basic in character, with minute chips of quartz and some chlorite'. Although this describes the thin section appearance of typical mudstones of the Boola Beds, they certainly are not tuffaceous in character.

Kenny (1937) mapped the limestone leases along the Tyers R. and described the general geology of the area in some detail. Portions of the area occurring in the Parish of Tanjil East had previously been mapped by Whitelaw (1926). Although Thomas (1942) had broadly elucidated the structure and stratigraphy of the Palaeozoic rocks of the Gould-Platina district, his work did not extend as far S. as the Tyers area. More recently the writer (1958) has given an account of the Jurassic rocks outcropping in the S. part of the area, (1960a) described in detail the squamulate favositids of the limestone horizons, and (1960b,c) given a preliminary account of the Tyers fauna and its bearing on Victorian Silurian and Devonian correlations. Talent and Philip (1960) also make brief mention of the limestone along the Tyers R. with regard to its probable sedimentary environment.

Geological Structure and Stratigraphical Subdivisions

The Palaeozoic rocks in this area are folded in a broad anticline with steeply dipping limbs. This structure has been traced further to the N. by Thomas (1942). Exposures of the Boola Beds, which occupy the core of the fold, are poor, and in the central part of the area the rocks are very strongly jointed and rubbly. Moreover, nowhere in the series is the bedding at all apparent. For these reasons reliable dip readings were almost impossible to obtain. Thus the anticlinal axis was recognized only in one place on the N. bank of the Tyers R. in the S. part of the area. The fold here has an extremely broad rounded crest with gently dipping limbs. It is almost symmetrical and plunges northward at about 12°. This plunge is apparently local, as 10 m. further N. at Coopers Creek the Boola Beds have virtually the same width of outcrop in the core of the fold.

No major faulting was recognized in the area, although minor faults were observed in many of the road cuttings and quarries. The stratigraphic subdivisions recognized within the area are:

(A) Boola Beds

This name is proposed for the thick, uniform mudstone series outcropping in the core of the Tyers anticline. Their base is not recognized, but they pass up conformably into the Coopers Creek Formation ('Basal Beds of the Walhalla Series'). The unit is thus the stratigraphical equivalent of the Tanjil Beds to the W., but as continuity with this unit cannot be proved, and because, due to its richly fossiliferous nature, the unit requires some reference name, this name is suggested, derived from the Parish name 'Boola Boola'. Should the '*Monograptus uncinatus*' horizon be recognized within the Tyers anticline, then this could provide a suitable base to the unit.

Lithologically the Boola Beds consist of massive mudstones usually without even a trace of bedding. Toward the core of the anticline and on its E. side they are strongly jointed. In thin section they consist of fine, poorly sorted, subangular quartz grains set in a matrix of chlorite, clay minerals and finer detrital material. They are grey-green in colour when fresh, but weather to a red-brown. Their absence of bedding and their strong jointing preclude any accurate measurement of their thickness, but it is estimated that they are at least 600 ft thick in this area.

In the top 100 ft of the unit the mudstones may become calcareous and strongly cemented with carbonate and so approach an impure limestone. Also toward the top of the unit are intercalated lenses of fine conglomerate consisting of sub-rounded chert fragments in a mudstone matrix. In the top 30 ft of the formation these may become dominant so that the junction between the Boola Beds and the overlying conglomerates of the Coopers Creek Formation is gradational. Although the lower part of the unit is virtually unfossiliferous, the upper part (the top 100 ft of the unit) contains an abundant invertebrate fauna. The distribution of fossil forms from the various localities within the Boola Beds is shown in Table 1.

(B) Coopers Creek Formation

This name is proposed for the limestone-conglomerate association which occurs on the flanks of the Tyers anticline. The name is taken from Coopers Creek further to the N., where the formation is more readily accessible, and from where it was first described adequately. The name replaces the term 'Basal Conglomerates and Limestones of the Walhalla Beds' present in the literature. The formation is a well-defined marker horizon in the Walhalla Synclinorium, where, on the W. side, it has been traced for over 50 m., and so it warrants a shorter and more correctly formed stratigraphic name.

The most notable feature of the formation is the very diverse and rapidly changing lithologies it exhibits. This has led to great difficulties not only in the quarrying for limestone but also in geological interpretation. It originally led Stirling (1899, p. 23) to postulate of the conglomerate that 'the breccia itself crosses the limestone belt and is of volcanic origin, occupying an immense strike fault in the Silurian rocks'. Later, Herman (1901) noted 'a gradual transition in texture can be traced from the coarse fossiliferous conglomerate to a schistose granular rock similar to that constituting the cementing matrix of the conglomerate; thence through fossiliferous shales with crinoid stems to highly calcareous encrinital shales, and finally to encrinital limestone or marble'.

Within the formation it is proposed to recognize the different lithologies as distinct sedimentary phases. It is not practicable to recognize members within the formation as the different rock types bear no relationship to their stratigraphic occurrence. Thus Thomas (1942) recognized 6 separate limestone lenses at Coopers

Creek at different stratigraphic levels within the conglomerate. He states (p. 359) that 'two small worked-out quarries between Coopers Creek and Platina Railway Station are at the base, three others are on the upper surface of the conglomerate, while White Rock Quarry is in the conglomerate but near the base'. The situation is not as complex as this in the Tyers area. On the W. side of the anticline the conglomerate is always at the base of the formation and passes up into a thick continuous limestone horizon. The only sizable limestone lens within the conglomerate is at the back of the old Tyers Quarry (Loc. 24). On the E. side of the anticline toward the S. the conglomerate is completely absent and a thick limestone horizon directly overlies the Boola Beds (Loc. 26, 27). To the N. of this the formation is virtually absent, represented merely by a thin calcareous conglomerate horizon.

Thus, not only do the lithologies of the formation vary rapidly but also does the thickness of the formation. On the W. side of the anticline at Tyers the thickness is of the order of 300 ft, the lower 50 ft or so usually conglomeratic, reaching a maximum thickness to the N. of over 400 ft. On the E. side the maximum thickness reached is slightly more than 300 ft, but, as has been mentioned, the formation is usually almost absent. 10 m. further N. at Coopers Creek the situation is very different as the main development of the formation (more than 500 ft thick) is on the E. side of the fold, with the minor outcrop to the W.

The sedimentary phases recognized were:

(1) CONGLOMERATE PHASE. Mapped as such are the rocks containing more than 50% pebbles. Although pebbles of igneous rocks are present within the conglomerate elsewhere (Junner 1914) here they were exclusively found to be of well rounded cherts, usually less than one inch across. The matrix of the conglomerate is of finer detrital material, or, more commonly, the conglomerate was apparently cemented by carbonate which has been lost on weathering. The conglomerate phase is usually confined to the base of the formation, but may occur toward the top (Loc. 33) and pebbles may be found throughout the limestone. In this area the conglomerate reaches a maximum thickness of 100 ft.

(2) LIMESTONE PHASE. The rock type representing this phase ranges from a typical grey limestone through into conglomeratic rocks or even silty, impure limestones. Typically toward its base the limestone is well bedded with the higher horizons more massive. In general it is a coarse calcarenite made up essentially of comminuted bioclastic debris, mainly corals, stromatoporoids and, to a lesser degree, algae. To the N. as in Boola Quarry, the rock approaches more a calcilutite, but exposures are poor in this part of the area away from the Tyers R.

(3) MUDSTONE PHASE. This term is used to describe mappable mudstone and sandy mudstone lenses within the formation. The phase is not well developed in this area, but at Coopers Creek thick mustones have been described within the formation (Thomas 1942).

A typical section through the formation is exposed along the Tyers R. in the vicinity of Loc. 18. Here the top members of the Boola Beds are seen to contain chert pebbles which become progressively more abundant higher in the section until the rock becomes a conglomerate with a mudstone matrix. In turn, this is replaced by a limestone cement, and, with a gradual decrease in the abundance of chert pebbles, the rock grades up into a limestone. All these rocks are well bedded in units usually slightly less than one foot thick. It is noteworthy that these beds within the base of the formation are graded. A typical bed from the base of the limestone

10 in. thick shows the lower part to be made up of large chert pebbles, rounded colonial corals, and large crinoid ossicles set in a coarse calcarenite. This coarse material slowly decreases in size up through the bed so that the upper 3 in. consists of a fine calcilutite, which in weathered specimens may be capped by a very thin, fine shale parting. This well bedded limestone passes up into more thickly bedded, massive limestone with no grading apparent within the units.

The exposures of the Coopers Creek Formation are particularly fine along the valley of the Tyers R., where the river follows the outcrop of the formation for over a mile. This allowed fairly detailed collecting, particularly of the limestone, from the river cliffs and natural exposures. The faunas of the various localities in the different sedimentary phases are tabulated in Table 1.

(C) WALHALLA BEDS

The Coopers Creek Formation is conformably overlain by the sandstones and mudstones of the Walhalla Beds. In this area the only fossils they were found to contain were plant remains.

Composition of the Tyers Fauna and Flora

In this section it is proposed to review the main groups of organisms identified in the collections from the Tyers area, particularly those not described in this paper.

SPONGES

One fragmentary sponge, possibly a receptaculitid, was collected from Loc. 21 in the Limestone Phase of the Coopers Creek Formation.

STROMATOPOROIDS

Stromatoporoids form a very important element in the fauna of the Coopers Creek Formation, both in species and relative abundance. The stromatoporoids of this area, together with those from the Lower and Middle Devonian limestones elsewhere in Victoria, are to be described separately, however the distribution of the species recognized is given in Table 1. 4 new species are present in the fauna, 3 of which are known only from this area, while the fourth is present also at Loyola (*Anostylostroma* sp. nov. A = *Clathrodictyon regulare* v. Rosen of Ripper 1937a). Those species previously recognized elsewhere in Victoria are *Stromatoporella granulata* from Lilydale, and recorded from Buchan by Talent (1956a), *Actinostroma verrucosum* (Goldfuss) from Lilydale, *Stromatopora bücheliensis* (Bargatzky) from Loyola and Lilydale, *S. foveolata* (Girty) from Lilydale, *S. typica* v. Rosen from Loyola, *Parallelopora lilydalensis* (Ripper) from Lilydale, *Hermatostroma loomberensis* (Dun) from Buchan (= *Hermatostroma episcopale* Nicholson of Ripper 1937b). *Amphipora ramosa* (Phillips) has been recorded from the Middle Devonian of Buchan by Teichert (in Teichert and Talent 1959), but the record is apparently based on the occurrence of a species of digitate calcareous alga, as this is all the writer has been able to discover at the stratigraphic level of his '*Amphipora*' biostrome in the Murrindal Limestone. The remaining 7 stromatoporoid species, previously described from Europe and Russia, are recorded from Australia for the first time.

Certain interest may be attached to this Lower Devonian stromatoporoid fauna, as faunas of this age are extremely rare throughout the world. As such it can be seen to be a peculiar admixture of Upper Silurian and Middle Devonian species known from elsewhere in the world. This may be illustrated best by the species of *Actinostroma*: *A. intertextum* Nicholson and *A. jurmanense* Yavorsky are elsewhere

TABLE 1

SPECIES	LOCALITY AND HORIZON																																																							
	COOPERS CREEK FORMATION																																					BOOLA BEDS																		
	Limestone Phase																										Conglomerate Phase																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	† 25	• 26	• 27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
STROMATOPOROIDEA																																																									
Anostylostroma sp. nov. A															r																																										
" " sp. nov. B			r												r																																										
Stromatoporella granulata (Nicholson 1873)											o		r		r																																										
Actinostroma sp. cf. *A. bifarium* Nich. 1886			o																																																						
A. intertextum Nich. 1886			r								r				o				r																																						
A. jurmanense Yavorsky 1955			r																									r																													
A. sp. cf. *A. salairicum* Yavorsky 1930								r																																																	
A. verrucosum (Goldfuss 1826)			r								o		r				r			r																																					
Trupetostroma sp. nov.															r																																										
Amphipora ramosa (Phillips 1841)			c		o						o				r																																										
Dendrostroma sp. nov.			?												o																																										
Stromatopora bücheliensis (Bargatzky 1881)			o										r							o																																					
S. sp. affin. *S. dybowskii* Yavorsky 1955											r																																													
S. foveolata (Girty 1895)			r								o		r		r																																										
S. secunda (Yavorsky 1955)			o					r			o					r											o	o																													
S. tenuilacunosa Yavorsky 1955			o								r				r					r																																					
S. typica v. Rosen 1867			o																																															r							
Parallelopora lilydalensis (Ripper 1937)			o			?													r	r																																					
Hermatostroma loomberensis (Dun 1918)			c										r																																												
TABULATA																																																									
Favosites gothlandicus Lamarck			r								r																																														
F. forbesi Edwards & Haime					?	r	o				c											r					c	r				r											r				o	a	o								
F. sp. affin. *F. forbesi* E. & H.																			r																																						
F. goldfussi d'Orbingy					r						o					?			r				r				o						r																								
F. hillae sp. nov.							r				o																r																														
F. coactilis sp. nov.			r								o				r												o																r				c	r									
F. allani Jones																r											r																														
F. sp. affin. *F. inosculans* Nich.																			r														?																								
F. macilentus sp. nov.											o																r																														
Favosites sp.											r																r																														
F. moonbiensis Etheridge																																															r	a	r								
F. squamuliferus forma *bryani* Jones	r				o	r	r		r	r	a		r	r	o	o		r	o			r		r		r	o						r																								
" " forma *nitidus* Chapman	o	r	r		o		o	r	r	r	a	r	o		r	r			o	o			o	r		r	c																				r										
" " forma *stelliformis* Chapman	r		r																r								r																														
" " forma *australis* Chapman											o									r			r				o																														
" " forma *ovatiporus* Hill & Jones											o																																														
" " forma ζ Philip																				r																																					
" " forma η Philip											r																																														
" " forma θ Philip			c								o				o				r	c																																					

r = rare; o = occasional; c = common; a = abundant; ? = questionable occurrence.

† Mudstone Phase interbedded with limestone. • Limestone Phase of Coopers Creek Formation on E. limb of anticline.

Table 1 (*continued*)

Species	Locality and Horizon																																																								
	Coopers Creek Formation																																						Boola Beds																		
	Limestone Phase																											Conglomerate Phase																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	† 25	• 26	• 27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Tabulata—*continued*																																																									
F. squamuliferus Etheridge (?)			r								r											r																																			
'*Emmonsia*' sp. cf. '*E.*' *fusta* Greene			r																																																						
Alveolites sp. affin. *A. taenioformis* Schlüter			r								r				r																																										
Alveolites sp.															r												r																														
Thamnopora alterivalis (Chapman)																r											o																														
T. boloniensis (Gosselet)											o																																								r						
Natalophyllum callidum sp. nov.															r					o																																					
Coenites (*Coenites*) *planifolium* sp. nov.																																															o	c	o								
Coenites (*Cladopora*) *foliata* Jones											o								r	r							c																														
Coenites (*Cladopora*) *gippslandica* (Chapman)	r			r							c				o	r		r	r	o	r	r				r	c								r	r				r			r				o	c	o								
Fossopora quintaria sp. nov.											o								r		r						o																														
Pleurodictyum megastoma McCoy																																			r	r							r				o		o								
Heliolites daintreei Nich. & Eth.							r				c				r				r	r		r					o						o															r	r								
Plasmopora gippslandica (Chapman)					r						r																																r					r									
Roemeria thomii (Chapman)																					r	r																																			
Aulopora sp. affin. *A. emergens* Quenstedt											o				r							r					r																				?										
Rugosa																																																									
'*Streptelasma*' spp.																																			r		r	o		r			a	r	r	r	r	r		o	o						r
Syringaxon (*Syringaxon*) sp.																																								o			r				o	o		o							
Syringaxon (*Barrandeophyllum*) sp.											r				o					o								r																													
S. (*Saucrophyllum*) *pocillum* subgen. et. sp. nov.						r					r								r														r		r					o								r		c							
Pseudamplexus princeps (Eth.)											?								r														r																								
P. princeps var. *confertus* var. nov.																			r			r	r				r																														
Heliophyllum sp. affin. *H. pinguiseptatum* Hill																				r																																					
Phillipsastrea maculosa Hill			r																	r																																					
P. speciosa Chapman															r																																										
Hexagonaria approximans (Chapman)						r			r		o					r				r				r																																	
Disphyllum cognatum sp. nov.																			o					r																																	
D. incongruum sp. nov.																					o																																				
Disphyllum (?) sp.											r																																														
Mictophyllum sp. affin. *M. cresswelli* (Chapman)																	r																																								
Thamnophyllum reclinatum Hill			o								r		o		a				r	a	o																																				
Trapezophyllum elegantulum (Dun)							r																																																		
Tipheophyllum ops sp. nov.											r				o																																										
Tipheophyllum sp.															r																																										
Tabulophyllum meridionale sp. nov.															r																																										
Acanthophyllum aequiseptatum Hill			r																																																						
A. clermontensis (Eth.)																				r																																					
A. mansfieldense (Dun)			o																o	o	r						r																														

r = rare; o = occasional; c = common; a = abundant; ? = questionable occurrence.

† Mudstone Phase interbedded with limestone. • Limestone Phase of Coopers Creek Formation on E. limb of anticline.

Table 1 (*continued*)

Species	Locality and Horizon																																																							
	Coopers Creek Formation																																					Boola Beds																	
	Limestone Phase																										Conglomerate Phase																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	† 25	* 26	* 27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Rugosa—*continued*																																																								
A. sweeti (Eth.)															r																																									
Dohmophyllum pridianum sp. nov.													r																																											
Xystriphyllum mitchelli (Eth.)											r																																													
Lyrielasma subcaespitosum praecursor subsp. nov.															o					r	r																																			
Tryplasma columnare Eth.					r																																																			
T. etheridgei sp. nov.																																																		c						
T. wellingtonensis Eth.			o																	r	r																																			
Tryplasma sp. A			r											r					r		r																																		
Tryplasma sp. B																																																c								
Microplasma sp. cf. *M. devonica* Soshkina																																																		o						
'*Cystiphyllum*' sp. cf. '*C*'. *australe* Eth.													r																																											
'*Cystiphyllum*' spp.																																																o								
Rhizophyllum (?) sp.																																																r								
Brachiopoda																																																								
Dolerorthis persculpta sp. nov.																																															o		o							
Onniella (?) *iversensis* sp. nov.																																								r			c				r											
Tyersella typica gen. et. sp. nov.		r									o							r											r	o	r			r	?	a													r		r									
Resserella impensa sp. nov.																																		r		o				r								o									
Isorthis festiva sp. nov.																																															o	r	o							
Schizophoria sp. indet.																																															r		r							
'*Gypidula*' *victoriae* Chapman																																											r													
Notoleptaena otophera Gill																																								r			o			r	r		r				r		r	
Leptaena sp. indet.	r										r										r																																			
Leptostrophia sp. affin. *L. affinalata* (Gill)																																											?			r									
Leptostrophia sp. cf. *L. explanata* (Sowerby)																																				r																				
Strophonella gippslandica sp. nov.																																															o		r							
Maoristrophia sp.																																				r																				
Megastrophia (?) sp.											r																																													
Cymostrophia sp. indet.																																															r		r							
Plectodonta bipartita (Chapman)																									?														r	o	r	r	a	o	r	r	r					o	r	r			
Notanoplia australis (Gill)																																															r									
Notanoplia sp.																																				r				r			a		r												
Chonetes cresswelli Chapman																																											o				r								
Chonetes sp. indet.						r					r						r																	r																							
Uncinulus (?) sp.	r		r								r				o					r	r						r				r			r																									
Atrypa sp. cf. *A. reticularis* (Linn.)	r							r			r				r															r	o		o	r	o	r											o		c							
A. fimbriata Chapman																																															r									
Plectatrypa australis sp. nov.																																															r	o								
Lissatrypa lenticulata sp. nov.																									r														r	o	r	r	c	r	r	r	r			r	o	o	r				r

r = rare; o = occasional; c = common; a = abundant; ? = questionable occurrence.

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Brachiopoda—*continued*																																																									
Eospirifer sp. cf. *E. togatus* (Barrande)											r				r											r																	r					o	r								
Delthyris (*Howellella*) *scabra* sp. nov.																																				r							r						o								
Meristella sp.																																											r														
Nucleospira sp.																																											r				r										
Lamellibranchiata																																																									
Actinopteria sp.																																				r											r										
Nuculites sp.																																											r														
Ctenodonta (*Ctenodonta*) sp. cf. *C.* (*C.*) *melbournensis* Chapman																																											r														
C. (*Praectenodonta*) *victoriae* (Chapman) subgen. nov.																																											o		r			r									
Cypricardinia sp.																																															r										
Conocardium costatum (Cresswell)													r																							r																					
Trilobita																																																									
Cheirurus (*Cheirurus*) sp.																																																							r		
C. (*Crotalocephalus*) *silverdalensis* Eth. & Mitch.																																											o				r	r	r								
Leonaspis bispinosa sp. nov.																																								r			c				r										
Gravicalymene angustior (Chapman)																																											r				o		o								

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† Mudstone Phase interbedded with limestone. * Limestone Phase of Coopers Creek Formation on E. limb of anticline.

confined to the Silurian, *A. salairicum* Yavorsky is a Middle Devonian species, *A. bifarium* Nicholson is a Middle and Upper Devonian species and *A. verrucosum* (Goldfuss) is also typically Devonian.

A similar interest may be attached to the coral fauna, which is described in some detail in this paper.

In Table 1 stromatoporoids appear to be much more abundant in certain localities than in others. This could be due largely to a bias in collecting as in those localities, because of the manner in which the rock was superficially weathered, they were much more apparent in the hand specimen than normally.

Stromatoporoids are virtually confined to the Coopers Creek Formation, particularly the limestone phase, only one solitary specimen of *Stromatopora typica* having been collected from a calcareous horizon in the upper part of the Boola Beds (Loc. 50).

TABULATE CORALS

Tabulate corals are by far the most important element in the Limestone Phase of the Coopers Creek Formation from the point of view of abundance, and they are commonly met with in the upper part of the Boola Beds. 28 species were recognized distributed through 13 genera and subgenera. 6 of the species are new.

Represented in the Boola Beds are 11 species, 2 of which, *Favosites moonbiensis* and *Coenites (Coenites) planifolium* sp. nov., are confined to that unit. Of the remainder *Pleurodictyum megastoma* ranges up into the Conglomerate Phase of the Coopers Creek Formation, but was not collected in the Limestone Phase. The rest continue through into the Limestone Phase of the Coopers Creek Formation where they are joined by 17 other species confined to that Formation. The species which survived the major facies change at the top of the Boola Beds then are *Favosites forbesi, F. coactilis, Thamnopora boloniensis, Coenites (Cladopora) gippslandica, Pleurodictyum megastoma, Heliolites daintreei, Plasmopora gippslandica*, and *Aulopora* sp. affin. *A. emergens*. The various formae of *F. squamuliferus* (*fide* Philip 1960a), which make up the majority of the specimens of tabulate coral collected from the limestone, are not represented in the Boola Beds except for a single specimen of *F. squamuliferus* forma *nitidus* collected from Loc. 47. Those species confined to the Coopers Creek Formation are *Favosites gothlandicus, F.* sp. affin. *F. forbesi, F. goldfussi, F. hillae, F. allani, F.* sp. cf. *F. inosculans, F. macilentus, Favosites* sp., *F. squamuliferus* (?), *'Emmonsia'* sp. cf. *E. fusta, Alveolites* sp. cf. *A. taenioformis, Alveolites* sp., *Thamnopora alterivalis, Natalophyllum callidum, Coenites (Cladopora) foliata, Fossopora quintaria*, and *Roemeria thomii*. Of these *F. forbesi, F. goldfussi, F.* sp. cf. *F. inosculans* occur in the conglomerate phase as well as the limestone phase.

The most common of the widely distributed species are *Favosites forbesi, Cladopora gippslandica*, and to a lesser degree *Heliolites daintreei*, while in the Limestone Phase of the Coopers Creek Formation, *Favosites squamuliferus* occurs in profusion.

RUGOSE CORALS

Rugose corals are widely distributed throughout the area. 32 species and varieties are described belonging to 21 genera. Of these, 6 species, one subspecies and one variety are described as new, and one new subgenus of *Syringaxon* is recognized. From the great number of indeterminate fragmentary remains in the collection it is estimated that at least a further 20 species are present in the fauna, mainly confined to the Coopers Creek Formation.

The rugose corals of the Boola Beds consist of fairly common solitary non-dissepimented or poorly dissepimented forms such as *Syringaxon*. In this category also are a number of small solitary species, usually preserved as moulds, similar to the species from the Melbourne district described by Chapman (1925) in the genus *Lindstroemia*. In the absence of sufficient specimens in which the hard parts were preserved no serious attempt was made to identify these forms. They are referred to as '*Streptelasma*' spp. in Table 1. These solitary forms range up into the basal conglomerate phase of the Coopers Creek Formation. Also present in the Boola Beds are the cystiphyllinids *Microplasma*, *Tryplasma*, *Rhizophyllum* (?) and indeterminate cystiphyllids. This fauna, composed mainly of solitary non-dissepimented forms, parallels the '*Cyathaxonia*' fauna of the Carboniferous (*fide* Hill 1948) in which the presence of such fauna is taken as an indication that their environment was water, 'cold, deep or murky'.

As opposed to this, the Limestone Phase of the Coopers Creek Formation contains many different species of large solitary dissepimented forms together with compound forms. 26 of the species described are confined to the Coopers Creek Formation, 5 are present only in the Boola Beds, and one was found in both units. This suggests that the rugose corals here were much more sensitive to their environment than were the tabulate corals as nearly one-third of the tabulate species survive the facies change between the Boola Beds and the Coopers Creek Formation.

Although many species are present in the limestone the only forms which are at all common are *Hexagonaria approximans*, *Thamnophyllum reclinatum*, *Acanthophyllum mansfieldense* and, to a lesser extent, *Pseudamplexus princeps*.

Rugose corals were found to be rare in the conglomerate phase of the Coopers Creek Formation. *Pseudamplexus princeps* was the only species collected apart from solitary laccophyllids and '*Streptelasma*'.

SCYPHOZOANS

A single fragmentary specimen of a species of *Conularia* was collected from Loc. 46 in the Boola Beds.

BRACHIOPODS

Brachiopods represent the most common element of the fauna of the Boola Beds and are also well represented in the Conglomerate Phase of the Coopers Creek Formation. However, they are extremely rare in the Limestone Phase. The common association of genera in the Boola Beds is *Lissatrypa* and *Plectodonta* sometimes joined by *Notoleptaena*, *Chonetes*, *Notanoplia* and more rarely *Onniella*. In the more calcareous horizons this fauna is to some extent replaced by other genera such as *Atrypa*, *Plectatrypa*, *Strophonella*, *Leptostrophia*, *Dolerorthis*, *Isorthis*, *Resserella*, *Tyersella*, *Howellella*, etc. Many of these forms, in particular *Tyersella*, *Resserella* and *Atrypa*, range up into the Coopers Creek Formation where they are commonly encountered in the Conglomerate Phase. *Uncinulus* (?) alone is widely distributed through the Coopers Creek Formation to which it appears to be confined. Other brachiopods, such as *Leptaena*, *Atrypa*, *Chonetes* and *Tyersella* are known only from a few fragmentary specimens from the limestone.

In all, it is estimated that over 35 brachiopod species are represented in the collection. Those forms not described here are known in general only from one or two incomplete valves which do not admit even of generic determination.

LAMELLIBRANCHS

Occasional lamellibranchs were found in various localities toward the top of the Boola Beds. Only the more complete of these are described in this paper. Lamellibranchs are rare in the Coopers Creek Formation where *Actinopteria* sp. and (?) *Conocardium costatum* (Cresswell) are known from single specimens in the conglomerate and limestone phases respectively.

GASTEROPODS

Fragmentary remains of gasteropods were collected from a number of localities toward the top of the Boola Beds, but most of the forms found were indeterminate apart from *Straparolus* sp. (Pl. XXIX, fig. 19) and a species of *Orthonychia*. Gasteropods in general were rare in the Coopers Creek Formation. At Loc. 21 and 22 in massive limestone on the bank of the Tyers R., sections through extremely large examples of a *Loxonema* type of gasteropod up to 8 in. high were seen. Also at Loc. 21 were present specimens of a large trochiform species probably related to the genus *Scalaetrochus*. These specimens could not be collected from the massive limestone. Small bellerophontid forms were also encountered in thin sections of the limestone from Loc. 4, 11 and 21. The gasteropods of the fauna are not described here.

PTEROPODS

Pteropods, mainly species of *Hyolithes*, were found widely distributed throughout the upper part of the Boola Beds. At least 3 species were present in the collection. It is noteworthy that the pteropod *Styliolina*, so characteristic of rocks of Tanjilian age elsewhere in Victoria, was not discovered in the Boola Beds. Pteropods were not discovered in the limestone or conglomerate.

NAUTILOIDS

Flattened remains of large orthoconic and more rarely breviconic nautiloids were encountered toward the top of the Boola Beds at Loc. 40, 41, 43, 45, 47, 48, 49. Other nautiloids were collected from the limestone at Loc. 11 and 27. One of the specimens from Loc. 11 was extremely large, slightly under one foot in length.

TRILOBITES

Trilobites, although virtually absent from the Coopers Creek Formation, were found to be widely distributed and fairly common in upper localities of the Boola Beds. 5 species are present in the collection, one of which, represented solely by a single fragmentary phacopid cephalon, is not described here.

OSTRACODES

Well preserved beyrichian ostracodes were abundant in localities toward the top of the Boola Beds. Ostracodes were also noted in some of the thin sections of the limestone. No attempt was made to identify the forms present.

ECHINODERMS

Crinoid stem ossicles were common in the upper part of the Boola Beds, and also throughout the Coopers Creek Formation, particularly in the limestone, which in places may be made of them to the exclusion of all other forms. No identifiable crinoid remains were discovered here, but further to the E., N. of Toongabbie, a crinoid fauna has been found on the same horizon as the Coopers Creek Formation. This is to be described elsewhere. A solitary, beautifully preserved brittle-star, probably conspecific with *Crepidosoma kinglakensis* Withers and Keble, was collected from Loc. 45. Chapman (1907) also records that spines of *Palaeechinus* are common in the limestone, but nothing in the present collection could be so identified.

PLANTS

Land plants of the same general type as *Yarravia* and *Hostimella* are abundant through the upper part of the Boola Beds and the Walhalla Beds, but were not found in the Coopers Creek Formation. One single specimen of *Baragwanathia* was collected from Loc. 45 in the Boola Beds.

Algae were often seen in thin sections of the limestone of the Coopers Creek Formation. Chapman (1907) described 3 species of *Girvanella* from the Tyers limestones. All these forms were seen in thin sections although no serious attempt was made to identify them. Also present at a number of localities is a species of digitate codiacid alga which will be described at a later date, along with those of other Devonian limestones of Victoria.

During the field work a particular search was made for fish remains, but none was found. Formanifera, worms and conodonts were not recognized in the collection.

Faunal Succession and Palaeo-Ecology

The lack of fossil localities in the central part of the Tyers anticline (Fig. 1) is due entirely to the unfossiliferous character of the lower part of the Boola Beds. In the stratigraphically lowermost of the fossil localities (Loc. 56, 57) fossils are extremely rare. At Loc. 56 a single specimen of *Notoleptaena otophera* was collected, while at Loc. 57 two specimens of *'Streptelasma'*, one of *Lissatrypa lenticulata* and fragmentary plant remains were obtained after a considerable time had been spent on the outcrop. Between about 300 ft and 150 ft from the top of the Boola Beds fossils are more common than this, but are by no means abundant. The common association is the brachiopods *Lissatrypa lenticulata* and *Plectodonta bipartita*, more rarely with *Notoleptaena otophera*, solitary corals and hyolithids. Still higher, about 150 ft from the base of the Coopers Creek Formation, these may be joined by other brachiopods such as *Chonetes, Notanoplia, Onniella, Eospirifer* and lamellibranchs. The more calcareous phases may also contain tabulate corals such as *Favosites* spp. and *Plasmopora*, and also trilobites and ostracodes. *Lissatrypa* and particularly *Plectodonta* occur in great numbers at this horizon. In the upper part of the Boola Beds, immediately beneath the Coopers Creek Formation, the unit may be highly calcareous and richly fossiliferous, containing abundant tabulate corals, brachiopods, and trilobites, but the *Plectodonta-Lissatrypa* association is absent, although these forms may be found in the more barren horizons surrounding the calcareous patches.

With the incoming of the basal conglomerate beds of the Coopers Creek Formation, the character of the fauna is changed, although many of the tabulate corals return in the more calcareous phases. Brachiopods such as *Tyersella, Resserella, Atrypa, Eospirifer* survive the facies change, but corals are rare. The conglomerates then gradually grade up into the limestone phase, with its rich and diverse coral-stromatoporoid fauna. It is of interest that both *Lissatrypa* and *Plectodonta* occur again in the Mudstone Phase of the Coopers Creek Formation. Presumably this represents a local return to a similar sedimentary environment to that of the Boola Beds.

It appears then that, during the deposition of the Boola Beds, conditions slowly became more favourable for the development of a large invertebrate community (or, at least, the preservation after death of such). Talent and Philip (1960) have suggested that this probably was due to a shallowing of the basin of deposition. The Coopers Creek Formation, with its basal conglomerate phase, represents a major change in the conditions of deposition, namely the entry of coarse detrital material into the sedimentary basin. It is noteworthy that the lower part of the formation is graded. This, together with the rolled and broken appearance of many of the fossils, suggests that at least the lower part of the formation was derived from a neritic zone elsewhere containing pebble banks, and, from the character of the fauna, coral-stromatoporoid reefs. This bioclastic debris and coarse detrital material was apparently deposited in the Tyers area by a type of density current deposition.

The incoming of the Walhalla Beds marked an abrupt end to this phase of deposition and a return to the normal geosynclinal sedimentation under which conditions most of the sediments of the Walhalla Synclinorium were deposited.

Age of the Sediments

This question has been dealt with in some detail elsewhere (Philip 1960b) together with the relation of the Tyers section to rocks of similar age elsewhere in Victoria (see also Addendum to this paper).

Briefly, the fauna of the Boola Beds suggests an Upper Silurian age (the genera *Lissatrypa, Plectatrypa, Dolerorthis* and perhaps *Resserella* appear to be confined to Silurian rocks elsewhere in the world). The only Devonian elements in the fauna are perhaps the trilobite *Cheirurus* (*Crotalocephalus*) *silverdalensis* (which, however, was originally described from the Silurian of Yass, N.S.W.) and the coral *Pleurodictyum* which apparently ranges down into the Silurian in E. Australia. On the other hand, the coral fauna of the Coopers Creek Formation, in comparison with those of the European sections, suggests an upper Lower Devonian age. This fact, together with other coral occurrences in E. Australia, has led the writer to suggest that a homotaxial relation exists between the shelly fossils and corals in comparison with the faunas of Europe. It has further been suggested that the facies change between the top of the Boola Beds and the Coopers Creek Formation should be taken as the Siluro-Devonian boundary in Victoria, as this represents a mappable horizon within the Walhalla Synclinorinm which approximates to this time boundary.

Although it is doubtful whether this horizon can be detected biostratigraphically in the sequences of Lilydale and Heathcote, another reason for its choice is that the entry of coarse clastics in the Tyers sequence at the base of the Coopers Creek Formation marks a definite phase in the tectonic history of the Tasman Geosyncline. It was probably due to the uplifting of Cambrian rocks along the Mt Wellington axis to the E. which can be correlated with the Bowning phase of the Palaeozoic orogeny in E. Australia. Thus the Bowning phase may be taken to be at the end of the Silurian in Victoria at least, and the effects of this phase may perhaps be likewise detected in the other sequences.

The Upper Silurian age of the Boola Beds on the basis of shelly fossils has an indirect bearing on the age of the *Baragwanathia* flora which occurs at the base of the Tanjil Beds (stratigraphical equivalent of the Boola Beds). Jaeger (1959) has recently suggested from illustrations that the species of graptolite which occurs associated with the flora is *Monograptus hercynicus* rather than *Monograptus uncinatus* as it has previously been identified. If this is so then the 'Tanjilian' is equivalent only to the Upper Ludlow.

However, Solle (1959) has suggested that the graptolites associated with the plants are derived from older rocks and the *Baragwanathia* flora is Devonian in age. Although this view is completely untenable on general grounds alone, it is of interest that the upper part of the equivalents of the Tanjil Formation are now dated as Upper Silurian on the basis of shelly fossils.

Systematic Descriptions

PHYLUM COELENTERATA

Class ANTHOZOA

In the coral descriptions below, the terminology is that of Hill (1956a) for rugose corals and that of Hill and Stumm (1956) for tabulate corals. Regarding the tabulate corals, some of the descriptive terms are to be found in Swann (1947) or have been discussed elsewhere (Philip 1960a).

Order TABULATA

With reference to the tabulate corals the monograph of Sokolov (1955) should be mentioned. A copy of this became available to the writer only after the section on corals was completed, so Sokolov's views are only mentioned when they have a direct bearing on the identification or interpretation of the Tyers specimens. The main feature of Sokolov's work is the extremely elaborate and artificial classification he proposes for the tabulate corals. In doing this, Sokolov has found no new taxonomic criteria on which to base his enormous number of suprageneric categories; the features used are the basis of the existing tabulate coral classifications, but whereas other authors have recognized and respected the extreme plasticity of the group, Sokolov has thrown all caution to the winds. Thus the suborders of his 'Tabulata Communicata' are based on features which I would regard as being of doubtful generic merit. However it is outside the scope of this present paper to review Sokolov's work, a task which in itself would be monumental.

Family FAVOSITIDAE Dana

Genus **Favosites** Lamarck 1816

Favosites gothlandicus Lamarck

(Pl. XI, fig. 1-2)

Favosites gothlandica Lamarck 1816, p. 206.
? *Favosites gothlandica* Lamarck, Chapman 1907, p. 72 (*partim*), Pl. 2, fig. 5.
Favosites gothlandicus Lamarck forma *gothlandica* Lamarck, Jones 1937, p. 86, Pl. 11, fig. 1-2 (see for corrections of earlier Australian occurrences); Hill and Jones 1940, p. 193; Hill 1954a, p. 42, Pl. 4, fig. 13a-b.

DESCRIPTION: Corallum globose, sub-hemispherical, diameter greater than 5 cm.

Corallites polygonal, gently radiating, diameter uniform, up to 3·5 mm, usually averaging about 2·5 mm; walls moderately thin, between 0·08 and 0·12 mm, but reaching up to 0·5 mm in places showing strong growth wrinkling.

Tabulae horizontal, flat, sometimes highly inclined for up to 3 cm in the one corallite; regularly spaced, 6 to 10 per cm, moderately thin.

Mural pores circular, typically biserial, alternate, occasionally slightly rimmed, spaced on the average 1 mm apart, ranging from 0·15 to 0·35 mm in diameter. Pore plates occasionally present.

No septal apparatus.

FIGURED SPECIMENS: T. 712-3 cut from M. 2888, Loc. 11, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 3 (rare), 11 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: The 3 ubiquitous Silurian species of *Favosites*, *F. gothlandicus*, *F. forbesi* E. & H. and *F. multiporus* Lonsdale were examined by Jones (1936) and considered to be conspecific. These morphological variants which were considered to be due to environmental differences, were regarded as 'formae' within the species *F. gothlandicus* (Jones 1936, 37; Hill and Jones 1940). That these formae were due solely to environment (i.e. ecotypes) can be argued against on general grounds alone. All 3 types may be found occurring side-by-side (Jones records all 3 from the Wenlock Limestone) and thus, as far as can possibly be judged, all existed under the same environmental conditions. It seems rather that the extreme variation exhibited by certain species groups of *Favosites* was due primarily to genotypic variability (Philip 1960a).

Within the collection investigated here, forms corresponding closely with *F. gothlandicus* and *F. forbesi* E. & H. (together with *F. goldfussi* d'Orb. which can well be regarded as belonging to the same species group) occur as stable morphological groups apparently with no intergradation. Accordingly they are regarded as species within their own right.

The only difference between the neotype of *F. gothlandicus* selected and described by Jones (1936) and the form identified as such from Tyers is the much thicker walls of the latter, 0·08 to 0·12 mm as opposed to 0·03 mm in the neotype. The extreme thickness of 0·5 mm given in the above description and present in T. 715 could well be due to a layer of secondary calcite deposited on the walls. In places this secondary layer has buttressed the tabulae which may then simulate septal spines. In Pl. XI, fig. 1 an infilling of drusy calcite is present also in places resembling septal spines.

Although *F. gothlandicus* is a species typical of Silurian rocks throughout the world (Europe, North America, Newfoundland, Asia, Korea, China and Russia) it should be noted that forms closely related to or indistinguishable from *F. gothlandicus* extend through into the Middle Devonian in various parts of the world. Some such species are *F. bohemicus* (Barrande) (Počta 1902; Schouppé 1954b) from the Lower and Middle Devonian of Bohemia and Austria; *F. helderbergiæ* Hall (Loewe 1914) from the Devonian of Ellesmereland; *F. goldfussi* var. *major* Frech (Reed 1908) from the Devonian of Northern Shen States. Further, in view of the similarity and consequent confusion between *F. forbesi* E. & H. and *F. goldfussi* d'Orbigny the time range of the other common Silurian species *F. forbesi* cannot be accurately determined.

The thicker walled forms of *F. gothlandicus* similar to the Tyers form appear to be more characteristic of the Devonian; for example close comparisons can be drawn between it and *F. bohemicus* var. *mosellana* Weissermel 1941 from the Lower Devonian of the Rheinische Schiefergebirge although the corallites of this form are slightly larger than is typical of the Tyers form.

By far the closest described species to the Tyers form is, however, *F. porfirievi* Chernyshev 1951 from the Lower Devonian of the Kuznetsk Basin. The specimen described by Chernyshev is very closely comparable to our form in all its dimensions. The comparison is complete in that *F. porfirievi* is said to be characterized by horizontal 'ribs' which are apparently the strong growth wrinkles of the corallites as they appear in a longitudinal section lying close to the plane of a wall. The only slight difference which can be seen in the two forms is a tendency for the corallites to be of unequal size in *F. porfirievi*. Whether or not this form is separable from *F. gothlandicus* it is impossible to judge from the material at my disposal. This highlights one of the main problems of favositid taxonomy. The characters by which species are defined are so few that it seems likely that certain 'species', e.g. *F. gothlandicus*, are in fact polyphyletic 'morphogens' with no true genetic relationship. For this reason, and also in view of the great variation which has been ascribed to the group by Jones, the species group of *F. gothlandicus* has been interpreted as conservatively as possible.

Favosites forbesi Edwards & Haime

(Pl. XI, fig. 4-5; Pl. XXI, fig. 5, 8, 9)

Favosites forbesi Edwards & Haime 1851, p. 238-9.

Favosites gothlandicus Lamarck forma *forbesi* Edwards & Haime, Jones 1936, p. 9-12, Pl. 1, fig. 5-7; Jones and Hill 1940, p. 193, Pl. 5, fig. 4a-b; Hill 1954a, p. 42, Pl. 4, fig. 14.

DESCRIPTION: Corallum variable, usually hemispherical, reaching a diameter of up to 7 cm, occasionally ramose or foliose.

Corallites polygonal, radiating or parallel depending on the shape of the corallum, occasionally showing dimorphism, more often almost uniform in size. Average diameter of corallites varying slightly from specimen to specimen, usually slightly greater than 2 mm, maximum size of corallites up to 3 mm. Where corallites are dimorphic the larger tend to be rounded and 8-sided and between 2 and 3 mm in diameter, the smaller 4-sided and less than 1 mm. Walls thin, between 0·06 and 0·20 mm, normally about 0·08 mm and showing growth crenulations.

Tabulae thin, in most cases horizontal, straight, occasionally imperfect, incomplete, inclined or slightly concave, in places suspended from septal spines, uniformly spaced about 12 per cm, but varying between 10 to 18 per cm.

Mural pores circular, uniserial or more often irregularly biserial, apparently unrimmed, diameter constant between 0·15 and 0·20 mm, spaced uniformly 0·7 mm apart when uniserial, up to 1 mm apart when biserial; pore plates usually present.

Septal apparatus of small, comparatively blunt, horizontally directed septal spines up to 0·13 mm in diameter at their base, circular in cross-section and extending up to 0·25 mm into the lumen. Septal spines arranged in irregular vertical columns about 0·3 mm between the centre of each spine, and up to 0·3 mm between each column, as many as 15 observed in one cycle.

FIGURED SPECIMENS: T.723-4 from M.2892, Loc. 27; M.2926, Loc. 11, Limestone Phase, Coopers Creek Formation. M.2931, Loc. 47; M.2909, Loc. 49, Boola Beds.

OCCURRENCE: Loc. 6 (rare), 7 (occasional), 11 (common), 22 (rare), 27 (common), Limestone Phase; Loc. 28 (rare), 32 (rare), Conglomerate Phase, Coopers Creek Formation; Loc. 43 (rare), 47 (occasional), 48 (abundant), 49 (occasional), Boola Beds.

REMARKS: One of the most striking differences between the Boola specimens of *F. forbesi* and material from Dudley, England, sectioned for comparison, was in the septal spines. In the specimens from Dudley the septal spines were up to 0·8 mm long, upwardly directed, and as many as 30 were present in one cycle in an adult corallite. The dimorphism of the corallites was also much more marked in the Dudley specimens. In view of the great variation in both these characters ascribed to this species by Jones (1936) it seems unwise to separate the Tyers form from *F. forbesi*, although it should be noted that Tripp (1933) places considerable taxonomic importance on the development of septal spines and their inclination.

Three other forms in the collection have been referred questionably to this species. The first, represented by T.718-9 from Loc. 27, has slightly larger corallites and also apparently fewer septal spines than is typical of the form identified here as *F. forbesi*, but this could well be due to the preservation of the specimen. In other respects it agrees with *F. forbesi*.

Two specimens from Loc. 5, Limestone Phase, Coopers Creek Formation

(T.756, M.2913 — T.757) appear to differ more significantly from *F. forbesi.* Both sections are through very small coralla, a little over 1 cm in diameter. The corallite diameter is up to 2·6 mm, wall thickness 0·05 mm. The distinction lies in the septal spines, of which there are only a few present. They are blunt, circular in cross section, and upwardly directed, extending up to 0·7 mm into the lumen, 0·2 mm thick at their base and retaining a thickness of 0·1 mm for most of their length. Mural pores were not observed, nor could the spacing of the tabulae be accurately estimated.

F. forbesi is one of the most widespread and common of the Boola favositids, surviving the facies change between the mudstone and the limestone-conglomerate phase.

Favosites sp. affin. **F. forbesi** Edwards & Haime

(Pl. XI, fig. 3)

Description: Corallum sub-hemispherical reaching a diameter greater than 4 cm.

Corallites polygonal, typically 6-sided, averaging 2 mm in diameter. Walls thin, up to 0·1 mm thick, but usually 0·05 mm.

Tabulae thin, horizontal or inclined, straight or occasionally concave, sometimes incomplete, often imperfect, in places suspended from septal spines, spaced about 15 per cm.

Mural pores circular to sub-ovate, with longest dimension horizontal, greatest diameter up to 0·4 mm, usually 0·35 mm but as little as 0·2 mm, uniserial but more typically biserial, spaced fairly uniformly at about 0·5 mm apart. Mural pores rimmed, pore plates usually present.

Septal apparatus of small, broad-based septal spines with slight upward curvature, extending up to 0·2 mm into the lumen, greatly increasing in number distally where they are arranged in poorly defined vertical columns about 0·2 mm apart.

Figured Specimen and Occurrence: T. 784, cut from M. 2925 with T. 783, Loc. 19, Limestone Phase, Coopers Creek Formation (rare).

Remarks: This form, represented in the collection by a single specimen, may be distinguished from *F. forbesi* primarily in the nature of the mural pores which are almost twice as big and twice as close as those typical of *F. forbesi.* There are also minor differences in the spacing of the tabulae and the nature of the septal spines. What appears to be an almost straight worm tube runs up the middle of one of the central corallites (see Plate) of this single specimen.

Favosites goldfussi d'Orbigny

(Pl. XI, fig. 6-9)

Favosites goldfussi d'Orbigny 1850, p. 107 (*partim*).
Favosites goldfussi d'Orbigny, Jones 1937, p. 94, Pl. 13, fig. 6, Pl. 14, fig. 7 (see for earlier Australian occurrences); Hill and Jones 1940, p. 194, Pl. 6, fig. 2a-b; Jones 1944, p. 34; Hill 1954b, p. 113 (*partim*), Pl. 8, fig. 19 (*non* Pl. 8, fig. 20a-b); Lecompte 1939 and Schouppé 1954b, give full discussion and synonymies for this species.

Description: Corallum sub-hemispherical, largest in collection greater than 6 cm in diameter.

Corallites polygonal, sub-parallel to strongly radiating, typically 5 or 6-sided, usually uniform in diameter and only occasionally showing a tendency toward dimorphism in size. Average diameter of corallites usually slightly under 2 mm, individual corallites up to 2·5 mm, fairly constant in size within the one corallum, but varying considerably between coralla (T.767—average diameter of corallites = 1·3 mm). Walls moderately thick, diameter between 0·10 to 0·30 mm, usually about 0·13 mm; intermural spaces occasionally present, reaching a maximum diameter of 0·2 mm.

Tabulae moderately thick (0·01 mm), usually horizontal, straight, sometimes highly concave when the tabulae are closely spaced, occasionally imperfect, incomplete or slightly inclined, very often suspended from septal spines. Spacing of tabulae fairly variable, between 8 to 24 per cm, usually about 12.

Mural pores circular to ovate with longest axis parallel to corallite walls, occasionally uniserial but more often irregularly biserial or even triserial, diameter between 1·4 and 3·7 mm, but usually about 2·5 mm. Spacing of mural pores irregular, up to 1·2 mm apart, commonly about 0·6 mm; pore plates mostly present.

Septal apparatus of comparatively pointed, discrete septal spines usually horizontally or upwardly directed. They are about 0·15 mm in diameter at their base, and extend up to 0·4 mm into the lumen, arranged in fairly regular vertical rows with up to 0·4 mm between each spine and with about 0·2 to 0·3 mm between each column.

FIGURED SPECIMENS: T.772 cut from M.2920, Loc. 5; T.764-5 cut from M.2916, Loc. 19; T.770 cut from M.2919, Loc. 23, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 5 (rare), 11 (occasional), 19 (rare), 23 (rare), 27 (occasional), Limestone Phase; Loc. 33 (rare), Conglomerate Phase, Coopers Creek Formation. One poorly preserved specimen (T. 779-80) from Loc. 16 is questionably referred to *F. goldfussi*.

REMARKS: Lecompte (1939) recognized two formae within the species *F. goldfussi*—firstly *F. goldfussi* forma *pyriformis* which is perhaps equivalent to *F. forbesi* var. *eifelensis* Nicholson (regarded by Jones 1936 as based on a 'young form' of *F. goldfussi*)—and secondly *F. goldfussi* forma *regularis*. The difference between these two is gradational, with *pyriformis* characterized by a pyriform corallum and dimorphism of corallites, which when adult are between 2 and 2·5 mm in diameter, whilst *regularis* has a discoidal corallum and slightly larger corallites which are uniform in size. The form here identified with *F. goldfussi* in general shows a fairly uniform corallite diameter although one section, taken from near the base of a corallum, does show a tendency toward dimorphism. The most salient differences between our material and that of Lecompte is that the corallites are smaller, averaging usually less than 2 mm and the tabulae are more distant, usually about 12 per cm as opposed to about 18 per cm in forma *regularis* and even more in forma *pyriformis*. In the size of the corallites and the spacing of the tabulae the species from Tyers is most closely comparable with the Couvinian species *F. saginatus* Lecompte 1939. From *F. saginatus* it differs in the thickness of the walls, and the development of the septal apparatus, both of which are more closely comparable to those of *F. goldfussi*. Thus the Tyers form is intermediate between these two.

F. goldfussi, as well as *F. gothlandicus* Lam. and *F. forbesi* E. & H., has been interpreted somewhat conservatively in view of the very conflicting definitions of different authors, and the great number of species, subspecies and varieties which belong to this species group. At the moment the most satisfactory solution is to equate our local forms with the European species, at the same time recognizing the minor differences between them.

Although Lecompte (1939) is not completely convinced that the Middle Devonian *F. goldfussi* is descended from the Silurian *F. forbesi*, Hill & Jones

(1940) and Regnéll (1941) have recognized the relationship between these species. It is of interest to note then that forms corresponding closely to these species co-existed in the limestones of the Coopers Creek Formation. Hill & Jones (1940) also describe both species from the Garra Beds, N.S.W.

The presence of intermural spaces in one corallum of this species is noteworthy. This appears to be the first record of such in the *F. gothlandicus-goldfussi* group.

F. goldfussi has also been collected from a limestone lens associated with the Coopers Creek Formation, near Telbit Road, Moondarra (T.1204-5; *vide* Thomas 1942, p. 358, for locality).

Favosites hillae sp. nov.

(Pl. XII, fig. 1-2; Pl. XIV, fig. 1-3)

Favosites goldfussi d'Orbigny, Hill 1954b, p. 113 (*partim*), Pl. 8, fig. 20a-b (*non* Pl. 8, fig. 19a-b).

non Favosites goldfussi d'Orbigny 1850, p. 107.

Diagnosis: Moderately thick walled *Favosites* with sub-rounded corallites about 1·3 mm in diameter; evenly spaced horizontal tabulae 30-38 per cm; mural pores circular, strongly pitted, approximately 0·2 mm in diameter, uniserial or occasionally biserial. Septal apparatus variably developed, sometimes almost absent where the walls are thin, usually of moderately long, upward-directed septal spines with as many as 12 in one cycle.

Description: Coralla fragmentary, largest fragment about 8 cm in diameter, apparently sub-hemispherical to sub-pyriform.

Corallites sub-polygonal to sub-rounded, usually 5 or 6-sided, strongly radiating to parallel, uniform in size, 1·2 to 1·5 mm in diameter, sometimes slightly less. Walls thickened, usually about 0·2 to 0·3 mm in diameter, difficult to estimate because of broad-based septal spines, about 0·1 mm where the septal spines are poorly developed; walls often with very thin intermural spaces up to 0·1 mm thick, usually much thinner, filled with clear calcite; growth lamellae low-angled.

Tabulae comparatively thick, horizontal, sometimes straight, but more often made slightly concave by the upward inflection of their edges, occasionally slightly inclined, imperfect or incomplete, very often suspended from septal spines, spacing uniform, 30 to 38 per cm, usually about 33.

Mural pores circular, set in deep, funnel-shaped pits, constant diameter of about 0·2 mm, uniserial with regular spacing between 0·6 and 0·8 mm, usually placed in the centre of the faces of the corallites, occasionally alternately biserial in larger corallites. Pore plates invariably present.

Septal apparatus variably developed. When well developed consists of pointed, discrete, upward-directed septal spines often curved upwards, extending up to 0·3 mm into lumen, with an extremely variable basal width, arranged in highly irregular vertical columns with about 0·3 mm between each spine and up to 0·5 mm between each column, but as little as 0·1 mm apart where the spines are exceedingly slender. Where poorly developed they consist of broad-based tubercular projections appearing often as irregular swellings in the walls (Pl. XIV, fig. 1). Up to 12 septal spines in one cycle, usually about 6.

Type Specimen: Holotype M.2927 — T.789-92, Loc. 11, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 7 (rare), 11 (occasional), 27 (rare), Limestone Phase, Coopers Creek Formation. One other poorly preserved specimen (T. 782) from Loc. 7 is questionably referred to this species.

This species also occurs in the Kiln Member of the Bell Point Limestone, Waratah Bay.

REMARKS: The irregular, funnel-shaped depressions around the mural pores are a striking characteristic of this species. In longitudinal sections of the faces of the corallites these depressions appear as large irregular holes of greater diameter than the mural pores when the section contains less than half the thickness of the wall. In longitudinal sections at right angles to this (i.e. where the mural pores are represented merely by discontinuities of the wall) the wall between each mural pore usually only gradually expands from the opening to reach its full thickness approximately half way between pores. The isolated pieces of wall thus have a rhombic outline in section and so simulate broad backed septal spines or squamulae, particularly as wide-based septal spines invariably are mounted at the apices (Pl. XIV, fig. 3).

This species bears little relationship to *F. goldfussi* d'Orbigny, although Hill (1954b) has previously identified it as such from the Bell Point Limestone of the Devonian of Waratah Bay. It differs from *F. goldfussi* in the smaller diameter of the corallites, the closer spacing of the tabulae, the strong pitting of the mural pores which are larger and also usually uniserial, and also in the thickness of the walls and the nature of the septal apparatus (cf. Pl. XI, fig. 6-9 with Pl. XIV, fig. 1-3).

Much closer comparison can be drawn with *F. styriacus* Penecke 1893, a species from the Lower Devonian of Austria. *F. styriacus styriacus*, as described by Schouppé (1954b), has only very slightly larger corallites (1·4 to 1·8 mm in diameter) and similar variable development of the septal spines and wall thickness. The mural pores, also, bear a strong resemblance to those of *F. hillae* although they are more typically biserial. The greatest difference appears to be in the spacing of the tabulae, which in *F. styriacus* is highly variable—1·5 mm apart in places, while in others 2 to 3 per mm. In *F. hillae* they are closely and regularly spaced at about 3 to 6 per mm. Also the septal spines are typically horizontal and much more numerous in Penecke's species. Comparison can also be drawn with *F. singularis* Sokolov (Obut 1939, Pl. 3, fig. 9-10) a species virtually identical with *F. styriacus perforatus* Schouppé 1954. In passing it may be noted that all illustrations of *F. singularis* Sokolov, placed by Sokolov (1955) in *Squameofavosites* Chernyshev 1941, show the species to possess irregular, broad-based septal spines similar to those of *F. hillae*, rather than squamulae as the term is generally defined.

Le Maitre (1934, Pl. 9, fig. 6) has figured a specimen from the upper Lower Devonian limestone of Chaudefonds as *F. styriaca* (*non F. styriacus* Penecke ?) which is closely comparable with *F. hillae* in the spacing of the tabulae and the size of the corallites as well as the uniserial pores. However it appears to lack the characteristic septal spines and counter-sunk mural pores of *F. hillae*.

Favosites coactilis sp. nov.

(Pl. XII, fig. 3-4; Pl. XIV, fig. 4-6)

Favosites sp. Chapman 1914b, p. 315, Pl. 56, fig. 26.

Favosites forbesi Edwards and Haime, (*partim*) Chapman 1914, p. 308, Pl. 56, fig. 27 *non* Pl. 53, fig. 19.

Striatopora sp. Hill 1954b, p. 115, Pl. 9, fig. 28a-b.

DIAGNOSIS: Sub-digitate *Favosites* with corallites gently expanding in axial region, bending sharply to emerge normal to surface of corallum. Corallites typically unequal in size particularly in axial region, mature corallites averaging about 1·2 mm in diameter. In axial region walls comparatively thin, about 0·17 mm in diameter but increasing to 0·5 mm distally. Tabulae about 14 per cm axially but more crowded distally with characteristic superior thickening of stereome; mural pores uniserial, about 0·2 mm in diameter and averaging 0·6 mm apart. Septal apparatus poorly developed axially but distally with small, upwardly directed septal spines.

Description: Corallum sub-cyclindrical, branching into broad blunt bushy expansions that may become united by later overgrowths. Branches usually slightly less than 2 cm in diameter, largest amalgamated corallum fragmentary, measuring 7 x 5 x 3 cm.

Corallites gently expanding in axial region of corallum, usually bending sharply through 90° when leaving axial region to emerge at right angles to the surface of the corallum, sub-polygonal to rounded in distal regions where the corallite walls are thickened. Mature corallites 1 to 1·3 mm in diameter, normally about 1·2 mm, fairly constant in diameter, often with smaller corallites interspersed particularly in the axial regions of the corallum. Walls thick, 0·15 to 0·20 mm, averaging about 0·17 mm in the axial regions, expanding up to 0·5 mm distally. Intermural spaces fairly well defined and constant in diameter, usually 0·05 mm across.

Tabulae thickened distally by peculiar superior layer of stereome, usually slightly less than 0·1 mm thick, but up to 0·3 mm thick; in axial regions thickening much less apparent, as little as 0·02 mm. Where a thickened tabula meets the corallite wall adjacent to the lower part of a mural pore, the pore plate of that mural pore may also show similar thickening. Tabulae usually horizontal, flat, slightly convex or concave, sometimes inclined, occasionally inosculating or incomplete in which case the tabula may rest on the one lower for the best part of its length. Tabulae well spaced axially with about 14 per cm, becoming more crowded distally with 20 to 26 per cm, usually about 24 per cm. Occasionally tabulae suspended from septal spines.

Mural pores circular to slightly ovate, usually set in large depressions, typically 0·18 to 0·20 mm in height and 0·15 to 0·18 mm in width, mostly uniserial in the centre of the corallite faces but rarely irregularly biserial, averaging about 0·6 mm apart but between 0·5 and 0·9 mm. Pore plates usually present, often thickened.

Septal apparatus poorly developed in axial region, consisting of occasional low wide-based projections into the lumen. Distally better developed, where small, usually upward directed septal spines extend up to 0·12 mm into the lumen, about 0·8 mm wide at base and irregularly arranged in vertical columns up to 0·2 mm apart and up to about 16 in one cycle.

Type Specimens: Holotype M.2949 — T.833-4. Paratype M.2950 — T.835, Loc. 11, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 3 (rare), 11 (occasional), 15 (rare), 27 (occasional), Limestone Phase, Coopers Creek Formation; Loc. 43 (rare), 47 (common as moulds), 48 (rare), Boola Beds.

Remarks: The thickening of the tabulae on their upper surfaces is a consistent character of this species. This type of thickening has already been described in certain North American favositids, viz. '*Emmonsia*' *radiata* (Rominger), *Favosites turbinata* Billings (Swann 1947) and *F. hamiltoniæ expansa* Ross 1953.

[Swann (1947) followed by Ross (1953) are among the recent authors who have regarded '*Favosites*' as feminine in gender. Here the genus is treated as masculine, as the Greek suffix '—ites' appears to be solely masculine, its feminine equivalent being —'itis'. (See also Declaration 40 of the International Commission in Zoological Nomenclature, 1958.)]

Ross (1953, p. 48) has regarded the stereome thickening of the tabulae as extensions of the peripheral stereomes of corallites on to the tabulae. In *F. coactilis* it appears to be distinct from that of the peripheral stereozones of the corallites. In poorly preserved specimens in which the peripheral stereozone is a pale buff colour, the thickened tabulae and pore plates are dark. In such cases the thickening does not appear to merge into the corallite walls, but stops abruptly against them. A similar demarcation can be seen in the better preserved specimens under crossed nicols. The stereome of the tabulae appears to be more fibrous and with a slightly stronger preferred orientation than that of the peripheral stereozone. A further difference between the two is that the walls of the corallites often contain considerable amounts of carbonaceous inclusions, whereas the tabulae never do. As such, the thickening of the tabulae apparently consists merely of an extension of the normal tabular deposits and thus would have been laid down by the ectodermal surface of the basal disc of the polyps. This parallels the stereome thickening the horizontal skeletal elements of certain scleractinians and rugose corals. It is impossible to imagine how the stereome could have arisen otherwise, considering that the peripheral stereozone was deposited in the upper 0·5 to 2·0 mm of the calyx (on the basis of growth lamellae) whereas the depth of the calyx is usually in excess of 6 mm (*fide* Swann 1947).

The form of the corallum of this species, typically cylindrical and branching and then at times amalgamated, with the apparently concomitant distal thickening of the corallite walls and distal crowding of the tabulae, is characteristic of quite a number of species of *Favosites*, although such features are usually regarded as of generic merit and so such species are placed in the genus *Thamnopora*. Among the Australian species this type of growth is seen also in *F. grandiporus* Etheridge 1890 from the Lilydale Limestone. Of the species showing this type of growth *F. coactilis* is perhaps closest to the Middle Devonian *F. gracilia* Ross 1953 which, however, is a squamulate species. *F. coactilis* is closely related to *F. hillae* in corallite diameter, septal apparatus and size and distribution of the mural pores.

Favosites allani Jones

(Pl. XII, fig. 5-6)

Favosites allani Jones 1937, p. 90-1, Pl. 12, fig. 4-5; Hill and Jones 1940, p. 190-1, Pl. 5, fig. 2a-b.

Description: Corallum sub-hemispherical, with radius about 3 cm.

Corallites 3 to 8-sided, usually about 6-sided, slightly rounded, very variable in size, up to 1·2 mm in diameter, but usually about 1 mm. Walls moderately thick, between 0·06 to 0·14 mm averaging about 0·08 mm. In transverse section intermural spaces very rarely visible and then only as a fine line of clear calcite; in longitudinal sections they are more apparent as irregular thickenings between the corallite walls.

Tabulae moderately thick, 18 to 23 per cm, usually about 20 per cm; individual tabulae as distant as 1 mm, usually horizontal, sometimes inclined. flat to highly concave, rarely convex, occasionally inclined. rarely incomplete or suspended from septal spines. Occasionally ill-defined zones of closely spaced tabulae present.

Mural pores strongly ovate to sub-circular, longest parallel to direction of growth, height up to 0·3 mm, usually about 0·2 mm with width between 0·17 mm and 0·12 mm. Usually uniserial toward the centre of the corallite faces, 0·4 to 0·7 mm apart averaging about 0·5 mm, very rarely irregularly biserial. Pore plates only rarely present so that, in longitudinal seetions, a particular tabula may appear to be continuous through the mural pores across as many as 3 adjacent corallites.

Septal apparatus of small, thorn-shaped spines, usually with a slight upward inclination and extending up to 0·2 mm into the lumen but usually less, with a base as much as 0·12 mm wide. Septal spines arranged in highly irregular vertical rows in which the spines are up to 0·3 mm apart. As many as 16 spines present in one cycle, but usually only about 8 visible.

FIGURED SPECIMEN: T. 822-3 from M. 2944, Loc. 27, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 16 (rare), 27 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: The two specimens from Tyers differ in a few minor respects from the descriptions of this species given by Jones (1937) and Hill and Jones (1940). The most noticeable of these is the size of the corallites which in the present form are about 1 mm in diameter, reaching a maximum of up to 1·2 mm. The usual diameter of the corallites in this species is between 1 and 2 mm. Jones does remark, however, that the corallite diameter is highly variable in *F. allani*. Other differences are in the ovate mural pores and shorter septal spines in the Tyers form.

The smaller corallite diameter suggests that the Tyers form is intermediate between *F. allani* and *F. regularis* Jones 1937 *non* Chapman 1921. It is possible, however, that *F. regularis* is in fact conspecific with *F. allani*.

Among overseas species *F. allani* is perhaps most closely allied to *F. punctatus* Boulier 1826 (Nicholson 1881, p. 19-20, Pl. 1, fig. 3a-c) from the Lower Devonian of Mayenne, a species with similar corallite diameter and spacing of tabulae. *F. punctatus* further is said to possess irregularly developed septal spines. The walls of this species however appear to be thinner, and the mural pores, although similarly distributed, are more often biserial and are apparently smaller.

One section (T. 822) shows corallites virtually lacking septal spines surrounding a damaged portion of the corallum. Again they do not appear at all well in T. 825, but this appears to be a function of the preservation.

Favosites sp. cf. **F. inosculans** Nicholson

(Pl. XV, fig. 1-2)

Cf. *Favosites? inosculans* Nicholson 1881. p. 20-1, Pl. 1, fig. 4-4a.
Cf. *Favosites inosculans* Nicholson, Le Maitre 1934, p. 169-70, Pl. 8, fig. 4-6; Kraicz 1935, p. 36-7, fig. 1, 3.
non Favosites inosculans Nicholson, Le Maitre 1931, p. 575, 7, Pl. 29, fig. 1-4. (cited Pl. 23, fig. 1-4).
non Favosites inosculans Nicholson, Le Maitre 1937, p. 113-4, Pl. 8, fig. 1-3.
non Favosites inosculans Nicholson, Flügel 1953, p. 65, 68 (*fide* Shouppé 1954b, p. 28).

DESCRIPTION: Corallum apparently hemispherical, known only from a single fragment.

Corallites gently diverging, lateral corallites becoming curved distally as they emerge normal to the surface of the corallum. Corallites rounded, up to 6-sided, fairly variable in size, up to 0·55 mm in diameter, usually about 0·4 to 0·5 mm, in transverse section up to 6 may appear interconnected through the large mural pores. Walls comparatively thick, up to 0·12 mm in diameter, usually about 0·08 mm, intermural spaces consistent in thickness where visible, about 0·02 mm thick.

Tabulae comparatively thick, very irregular in distribution, 1·5 to 0·1 mm apart, about 20 per cm, flat or sometimes concave, horizontal or more often inclined, sometimes steeply, rarely incomplete.

Mural pores usually ovate to circular, comparatively large, usually about 0·2 mm by about 0·15 mm in a single row in the centre of the corallite face, with longest dimension parallel to the growth direction, 0·5 to 0·8 mm apart, usually about 0·6 mm. Mural pores with moderate pitting (i.e. depressed), which together with slight flexing of corallite walls gives the irregular longitudinal sections.

Septal apparatus of small linguiform squamulae, horizontal or with a slight upward inclination, thickening toward the base, where in longitudinal section they are about 0·02 mm thick, extending up to 0·1 mm into the lumen with width constant for their entire length, even expanding to reach their greatest width half way to the rounded distal end, up to 6 in one cycle, usually about 3 visible in one corallite, often obscured by secondary deposits of calcite.

FIGURED SPECIMEN AND OCCURRENCE: M.2947 — T.826-7, Loc. 19, Limestone Phase, Coopers Creek Formation.

REMARKS: There exists a certain doubt as to the nature of *F. inosculans.* For example Le Maitre (1931, 34, 37) has illustrated three different forms as this species, of which the second appears to be conspecific with Nicholson's species. The first is closely comparable with *F. squamuliferus* forma *nitidus* Chapman while the third is probably conspecific with *F. grandiporus* Etheridge 1890 (*fide* Philip 1960a). One's interpretation of these specimens is not helped by Le Maitre's descriptions which are identical in the first two of these references although very different specimens are illustrated.

The specimen figured by Le Maitre (1934) agrees with Nicholson's description of the species. It should be noted, however, that Nicholson remarks on the absence of septal spines (as does also Le Maitre) in this species but what appear to be small, flattened, linguiform squamulae, very similar to those described in the Tyers form, are present in Le Maitre's fig. 5. Le Maitre (1937) does mention the presence of occasional septal spines in this species, but the specimen figured is not *F. inosculans.*

The salient character of the species, the inosculating nature of the corallite walls in transverse sections, is apparent in the specimen from Tyers. Hill and Jones (1940) have considered this inosculating appearance to be due to the fact that the mural pores are often at the angles of the corallites, so that three corallites may communicate. Rather it would appear to be due to the fact that the comparatively large mural pores are at the same height in adjacent corallites. The form from Tyers differs from *F. inosculans* in the greater separation of the mural pores which are about twice the distance apart and in the more distant, irregular tabulae. Should more material come to hand and establish that these differences are consistent, then it would be wise to recognize our Australian form as a separate subspecies.

Comparison can be drawn between *F. inosculans* Nich. and *F. favisitoides* (Ozaki 1934), the type species of *Sapporipora* Ozaki 1934, from the Silurian of Korea. They are similar in the size of corallites, spacing of the tabulae and the size and distribution of mural pores, although *F. favisitoides* does not possess the inosculating character of the corallite walls in transverse section. Further, the walls are thinner in *F. favisitoides* which also appears to possess a specialized mode of increase.

Favosites macilentus sp. nov.

(Pl. XIV, fig. 7-8)

DIAGNOSIS: Corallum discoidal; small corallites of variable size averaging 0·5 mm in diameter; walls averaging 0·1 mm in thickness; tabulae about 30 per cm; mural pores ovate, greatest dimension 0·16 mm, widely biserial at the edge of the faces on which they occur, about 1·7 mm apart in their respective columns. Septal apparatus of occasional, thin, horizontal septal spines.

DESCRIPTION: Largest corallum discoidal, up to 3 cm in diameter, 1·5 cm high.

Corallites subpolygonal to rounded, parallel to slightly radiating, variable in size, irregularly dimorphic, or with clusters of larger corallites up to 1 mm in diameter interposed with smaller corallites, average diameter about 0·5 mm. Larger corallites 6 or 7-sided, smaller usually 5-sided. Walls thickened around larger corallites, up to 0·2 mm in diameter, usually about 0·1 mm, sometimes less. Intermural spaces fairly persistent, up to about 0·04 mm in diameter, in longitudinal sections often showing thickening at similar heights in adjacent corallites.

Tabulae moderately thin, horizontal, flat or slightly concave or convex, rarely irregularly inosculating, in places suspended from septal spines, spaced uniformly between 28 and 33 per cm, and up to 0·6 mm between individual tabulae.

Mural pores ovate with longest dimension in direction of growth, usually between 0·15 and 0·17 mm by about 0·1 to 0·12 mm, widely biserial, alternate, at the edges of the faces of which they occur, averaging about 1·7 mm apart in their respective columns.

Septal apparatus of thin elongate septal spines, with horizontal or slightly upward inclination, circular in cross-section, extending up to 0·15 mm into the lumen, about 0·4 mm in width which remains constant to the rounded distal extremity. As many as 6 septal spines in one cycle, usually only very few visible in transverse sections. Apparently irregularly arranged within the corallites.

TYPE SPECIMEN: Holotype M.2956 — T.850-3, Loc. 11, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 11 (occasional), 27 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: This species, in the location of the mural pores towards the edges of the faces of the corallites, recalls *F. asper* d'Orb., the type species of *Paleofavosites* which includes species differing from *F. gothlandicus* Lamarck merely in this respect. This, as with other characters which have been used to split the genus *Favosites*, is an extremely arbitrary feature for even in *F. asper* itself there is present a wide variation in the location of the mural pores (Jones 1936).

However, a distinction should be drawn between the mural pores in *F. macilentus* and *F. asper*. In *F. macilentus* the mural pores, although at the extreme edge of the faces on which they occur, never are located at the corners of the corallites so that more than two are in communication.

F. macilentus differs from *F. asper* and related species in the small size of the corallites, the spacing of the tabulae and the septal apparatus. It bears very little relation to any local or overseas species. *'Paleofavosites' arcticus* Poulson 1941, from the Silurian of North Greenland, has similar corallite diameter but much closer tabulae.

Favosites sp.

(Pl. XIII, fig. 3-4)

DESCRIPTION: Corallum apparently sub-hemispherical, known only from fragments.

Corallites polygonal, usually 5 or 6-sided, parallel or gently expanding, uniform in size, averaging 1·2 mm with occasional smaller corallites present. Walls comparatively thin, up to 0·08 mm, usually about 0·06. Thin linear intermural spaces often present between the corallite walls.

Tabulae moderately thick, usually flat and horizontal, sometimes inclined or incomplete, occasionally inosculating, regularly spaced between 25 to 30 per cm, usually about 28.

Mural pores circular, diameter up to 0·23 mm, usually 0·18 mm, closely spaced, usually irregularly biserial or triserial, very occasionally uniserial.

Septal apparatus absent.

FIGURED SPECIMEN: T.1055-6 from M.3009, Loc. 27, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 11 (rare), 27 (rare), Limestone Phase, Coopers Creek Formation. The specimen from Loc. 11 is poorly preserved and infilled with a layer of drusy calcite but undoubtedly is conspecific with this form.

REMARKS: This species of *Favosites* differs from other Australian species of comparable corallite diameter and tabulae spacing (*F. moonbiensis*, *F. allani*, *F. squamuliferus*) in the character of the mural pores. It is, however, almost identical in every respect with the species identified as *F. hisingeri* Edwards and Haime by Chernyshev (1951) from the Upper Silurian of the Kuznetsk Basin. Although Chernyshev describes the septal spines as 'very well developed and upwardly directed' they are not visible in his figures. *F. hisingeri* is a species characterized by strongly developed septal spines.

Favosites moonbiensis Etheridge

(Pl. XII, fig. 7-8; Pl. XXI, fig. 4)

Favosites basaltica (Gold.) var. *moonbiensis* Etheridge 1899a, p. 164-5, Pl. 24, fig. 1-2, Pl. 29, fig. 2; Jones 1937, p. 96, Pl. 15, fig. 1-2.

Favosites basalticus (Gold.) var. *moonbiensis* Etheridge, Jones 1944, p. 34.

DESCRIPTION: Corallum flattened, sub-hemispherical to discoidal, largest corallum in collection with diameter of 10 cm. Basal epitheca present.

Corallites sub-polygonal, with rounded corners, usually 6-sided, gently radiating to parallel, uniform in size with an average diameter of about 1·2 mm but up to 1·5 mm; occasionally smaller corallites are present. Walls moderately thick, 0·08 to 0·20 mm at the corners, usually slightly in excess of 0·1 mm; intermural spaces usually present at the corners of the corallites, and extending a little distance from the corners in between the corallite walls, giving rise to poorly defined 'stellate' structures at the corners of the corallites, ill-defined in longitudinal sections.

Tabulae thin, horizontal, usually slightly convex, sometimes flat, very rarely concave, occasionally inclined, incomplete or imperfect, very rarely inosculating. Spacing of tabulae 24 to 30 per cm, usually about 28, individual tabulae up to 0·8 mm apart; ill-defined zones in which the tabulae are closer are sometimes present.

Mural pores circular to very slightly ovate with longest dimension parallel to the direction of growth, diameter 0·19 to 0·25 mm, usually slightly in excess of 0·2 mm, typically irregularly uniserial toward the centres of the corallite faces, 0·5 to 0·8 mm apart, usually about 0·65 mm, very rarely widely biserial opposite or alternate, in which case the mural pores are very much toward the edges of the corallite faces, although the spacing remains the same. Mural pores set in a very slight depression, occasionally with a slight thickening of the wall above the mural pores. Pore plates usually absent.

Septal apparatus absent.

FIGURED SPECIMENS: T.798, 800 from M.2932, Loc. 48; M.2940, Loc. 47, Boola Beds.

Occurrence: Loc. 47 (rare), 48 (abundant), 49 (rare), Boola Beds.

Prior to this, *F. moonbiensis* has been recorded from rocks of Middle Devonian age.

Remarks: The writer (1960a), on the basis of marked similarity between this species and *F. squamuliferus* forma *bryani*, has suggested that *F. moonbiensis* represents merely a modified form of *F. squamuliferus* in which the septal apparatus is absent. This was considered to have been caused by environmental differences as *F. moonbiensis* is confined to the mudstone facies of the Boola Beds whereas the various formae of *F. squamuliferus* occur virtually exclusively in the limestone facies of the Coopers Creek Formation. It should be noted, however, that *F. moonbiensis* does not show the extreme variation of *F. squamuliferus*, but can be defined within strict limits of variation.

Etheridge (1899a) has already noted the intermural spaces at the corners of the corallites in this species. They are aparent in his Pl. 24, fig. 2 as well as in the illustration of this species given by Jones. Of them, Etheridge (p. 165) states—'At the angle of a corallite a light clear spot is visible in the wall substance, but on vertical examination there is not the slightest trace of any structure after the nature of an acanthopore'. These light spots may be intermural spaces or can be caused by bleaching of the stereome of corallites in the vicinity of intermural spaces.

F. moonbiensis is closely comparable with *F. proasteriscus* Charlesworth 1914 from the Lower Devonian of the Carnic Alps and *F. interstinctus* Regnéll from the Siluro-Devonian of Chöl-tagh, Eastern Tien-shan. Both these species possess similar intermural deposits.

Favosites squamuliferus Etheridge

Favosites squamutifera Etheridge 1899a, p. 166-7, Pl. 38, fig. 4-5.
Favosites squamuliferus Etheridge, Philip 1960a.

The writer (1960a), on the basis of a detailed study of the squamulate favositids occurring in the Limestone Phase of the Coopers Creek Formation in this area, concluded that, of the 13 specific names proposed for Australian species of squamulate favositids, 2 alone could be regarded as valid species. These were *F. grandiporus* Etheridge 1890, known only from the Lilydale Limestone, and *F. squamuliferus* Etheridge 1899. *F. squamuliferus* was interpreted as a species exhibiting particularly gross variation and so was separated into 8 arbitrarily chosen formae. For completeness brief diagnoses and the occurrences of the various formae of *F. squamuliferus* are given here. Full synonymies and descriptions are given in the paper mentioned above.

To the list of 11 overseas species given by the writer which fall within the morphological range exhibited by *F. squamuliferus*, a further Russian species may be added. It is *Emmonsia taltiensis* Yanet *in* Sokolov 1955, Pl. 14, fig. 6-7, Middle Devonian, Urals. This form is indistinguishable from *F. squamuliferus* forma *bryani* in which the tabulae are closely spaced.

F. squamuliferus forma bryani (a) Jones

(Pl. XIII, fig. 1-2)

Diagnosis: Corallum massive, corallites polyhedral averaging greater than 0·8 mm in diameter and usually less than 1·5 mm; mural pores uniserial, circular to slightly ovate, between 0·15 and 0·35 mm in diameter and between 0·3 and 0·8 mm apart. Squamulae highly variable, horizontal or upwardly directed, developed either back-to-back in adjacent corallites above the mural pores or isolated. Slender septal spines may also be present.

Figured Specimens: T.891 from M.2973, Loc. 11; T.917 from M.2982, Loc. 11, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 1 (rare), 5 (occasional), 6 rare), 7 (rare), 9 (rare), 10 (rare), 11 (abundant), 13 (rare), 14 (rare), 15 (occasional), 16 (occasional), 18 (rare), 19 (occasional), 22 (rare), 24 (rare), 26 (rare), 27 (occasional), Limestone Phase, Coopers Creek Formation; Loc. 33 (rare), Conglomerate Phase, Coopers Creek Formation.

F. squamuliferus forma nitidus (β) Chapman

Diagnosis: *F. squamuliferus* with average corallite diameter between 0·8 and 0·5 mm.

Occurrence: Loc. 1 (occasional), 2 (rare), 3 (rare), 5 (occasional), 7 (occasional), 8 (rare), 9 (rare), 10 (rare), 11 (abundant), 12 (rare), 13 (occasional), 15 (rare), 16 (rare), 19 (occasional), 20 (occasional), 23 (occasional), 24 (rare), 26 (rare), 27 (common), Limestone Phase, Coopers Creek Formation; Loc. 47 (rare), Boola Beds.

F. squamuliferus forma stilliformis (γ) Chapman

Diagnosis: *F. squamuliferus* with corallite diameter less than 0.5 mm.

Occurrence: Loc. 1 (rare), 3 (rare), 19 (rare), 27 (rare), Limestone Phase, Coopers Creek Formation.

F. squamuliferus forma stelliformis (γ) Chapman

(Pl. XV, fig. 3-4)

Cannapora australis Chapman 1907, p. 76, Pl. 3, fig. 6-7; Pl. 8, fig. 17-18.

Diagnosis: *F. squamuliferus* with small corallite diameter and sub-cerioid growth.

Figured Specimen: T. 937-8 from M. 2989, Loc. 11, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 11 (occasional), 20 (rare), 23 (rare), 27 (occasional), Limestone Phase, Coopers Creek Formation.

Remarks: This species was described by Chapman from the limestones along the Tyers River.

F. squamuliferus forma ovatiporus (ε) Hill and Jones

Diagnosis: *F. squamuliferus* with large, ovate mural pores, reduced squamulae and well spaced tabulae.

Occurrence: Loc. 11 (occasional), Limestone Phase, Coopers Creek Formation.

F. squamuliferus forma ζ Philip

Diagnosis: *F. squamuliferus* with small distant mural pores, reduced squamulae and well spaced tabulae.

Occurrence: Loc. 20 (rare), Limestone Phase, Coopers Creek Formation.

F. squamuliferus forma η Philip

DIAGNOSIS: *F. squamuliferus* with exceedingly thin walls.

OCCURRENCE: Loc. 11 (rare), Limestone Phase, Coopers Creek Formation.

F. squamuliferus forma θ Philip

DIAGNOSIS: Sub-digitate thick-walled *F. squamuliferus* with irregularly spaced mural pores and reduced squamulae.

OCCURRENCE: Loc. 3 (common), 11 (occasional), 15 (occasional), 19 (rare), 20 (common), Limestone Phase, Coopers Creek Formation.

F. squamuliferus Etheridge (?)

(Pl. XIII, fig. 5-6)

Favosites (Emmonsia) spinigera Chapman 1921, p. 214-5, Pl. 9, fig. 21.
non Favosites spinigera Hall 1879, p. 108, Pl. 4, fig. 1-5.

DESCRIPTION: Corallum known only from fragments but apparently sub-hemispherical.

Corallites polygonal, variable in size, up to 2·2 mm, but averaging 1·4 mm, usually 6-sided. Walls reaching 0·3 mm in diameter but usually slightly less than 0·1 mm, slightly thickened at the corners, often with thin, clear, linear intermural spaces.

Tabulae about 20 per cm but highly variable in spacing, usually incomplete, suspended or resting on a lower tabula, often highly curved or contorted.

Mural pores circular, uniform in size, averaging 0·2 mm in diameter, uniserial toward the middle of the corallite faces or widely biserial; pore plates usually present.

Septal apparatus of strongly developed squamulae and very occasional, thin, discrete septal spines. Squamulae in transverse sections up to 0·2 mm in width at their base, often expanding along their length and distally rounded. In longitudinal sections triangular, up to 0·25 mm thick at their base, but usually less, strongly tapered, usually horizontal or upwardly directed, in places extending over half way across the lumen, as close as 0·4 mm apart in longitudinal sections and as many as 5 visible in the one corallite in transverse sections. Squamulae usually occurring isolated, but may be back-to-back above the mural pores.

FIGURED SPECIMEN: T.1043-4 from M.3007, Loc. 11, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 3 (rare), 11 (rare), 22 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: The writer (1960a) has placed *F. spinigera* Chapman 1921 in the synonymy of *F. squamuliferus* forma *bryani* Jones. Since then there has come to light in the Chapman collection purchased by the Melbourne University Geology Department two sections of *Favosites* from Deep Creek, Gippsland. One of these (now catalogued T. 1203) labelled merely 'Deep Creek, 7 miles SE. of Walhalla' is undoubtedly from the misplaced type of *F. spinigera* which Chapman described from this locality. The only difference between this slide (Pl. XIII, fig. 7) and the form from Tyers is in the squamulae which are less crowded, not so wide and so more rounded in cross-section, which allows the tabulae to appear more complete in longitudinal section. Thus Chapman's specimen is intermediate between our present form and *F. squamuliferus* forma *bryani*.

Whether this form is merely a further forma of *F. squamuliferus* characterized by exceedingly strongly developed squamulae or actually constitutes a separate species, it is impossible to say from the material available. The specimens from Loc. 3 and 22 are so poorly preserved that they throw little light on the problem. In view of the gross variation shown by *F. bryani*, however, the former is the more likely.

Chapman's other slide (T. 1202) from Deep Creek is of *F. squamuliferus* forma *nitidus* Chapman.

'Emmonsia' sp. affin. **'E.' fusta** Greene

(Pl. XIII, fig. 8)

Affin. *Favosites fustus* Greene 1906, p. 37, Pl. 9, fig. 3-4.
Affin. *Emmonsia fusta* Green, Stumm 1949a, 'Tabulata', card 203.

DESCRIPTION: Corallum known from one section only, small, subpyriform, attached to a crinoid stem.

Corallites about 2 mm in diameter, apparently polygonal, walls usually slightly less than 0·2 mm thick.

No tabulae observed crossing lumen, apparently all broken as specimen now filled with limestone matrix. Mural pores small, circular, 0·12 to 0·22 mm in diameter, averaging about 0·15 mm, irregularly biserial or triserial.

Septal apparatus of thin-based, upwardly directed squamulae extending up to 1 mm into lumen but commonly less, slightly tapered in longitudinal section, as close as 0·2 mm apart vertically; relation to mural pores unknown.

FIGURED SPECIMEN AND OCCURRENCE: T.1052 from M.3008, Loc. 3, Limestone Phase, Coopers Creek Formation.

REMARKS: Of the species generally included in the polyphyletic grouping *Emmonsia* E. and H., this form, as far as can be interpreted from this single fragmentary specimen, bears closest resemblance to *'Emmonsia' fusta* Greene from the Middle Devonian of Ohio.

Genus **Alveolites** Lamarck 1801

Alveolites sp. affin. **A. taenioformis** Schlüter

(Pl. XV, fig. 5)

Affin. *Alveolites taenioformis* Schlüter 1899, p. 121; Lecompte 1939, p. 55-6, Pl. 8, fig. 3-4; Stasinska 1958, p. 214-6, Pl. 25, fig. 1-2; Pl. 26 (*cum. syn.*).

DESCRIPTION: Corallum laminar, composed of irregular layers up to 4 mm thick in which the corallites are more or less horizontal.

Corallites sub-triangular to sub-lunate averaging slightly less than 0·2 mm in height and about 0·4 mm in width; most sections are oblique so the corallites appear with a greater width. Walls moderately thick, usually 0·08 mm in diameter but reaching up to 0·12 mm in places.

Tabulae straight, irregularly spaced, and not common, in places they may be as close as 0·2 mm apart but usually much more distant. Mural pores circular to slightly ovate averaging 0·1 mm in diameter and about 0·45 mm apart, contained in the corners of the corallites.

Septal spines absent.

FIGURED SPECIMEN: T.917 from M.2982, Loc. 11, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 3 (rare), 11 (rare), 15 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: This form, known only from 3 fragmentary specimens, is strikingly similar to the Couvinian and Lower Givetian species *Alveolites taenioformis* Schlüter. It differs from that species essentially in the more irregular spacing of the tabulae and in the mural pores, which are slightly larger and closer. If these differences prove to be consistent in the light of further material, then it would be best to separate the Tyers form from Schlüter's species. The material to hand is not sufficient on which to base a new species or sub-species.

Alveolites sp.

(Pl. XV, fig. 6)

DESCRIPTION: Corallum apparently an irregular hemispherical mass at least 3 cm in diameter.

Corallites sub-lunate to sub-polygonal 5 or 6-sided, height constant at 0·3 mm, usually about 0·4 mm wide, but up to 0·6 mm. Walls usually slightly less than 0·05 mm, but up to 0·08 mm thick.

Tabulae moderately thick, slightly concave, distant, usually about 0·8 mm apart but may be more crowded where the corallum is damaged. Mural pores ovate with longest dimension in the direction of growth, 0·19 mm by 0·17 mm, spacing not known, usually situated in the angles of the corallites when they are sub-lunate in shape, but may be in the centre of the faces where corallites are sub-polygonal.

Thin septal spines occasionally present.

FIGURED SPECIMEN AND OCCURRENCE: T.1062, Loc. 27, Limestone Phase, Coopers Creek Formation. A further poorly preserved specimen from Loc. 15 also probably belongs to this species.

REMARKS: This species is apparently new, but the material is such that positive identification is impossible.

Genus **Thamnopora** Steininger 1831

Thamnopora alterivalis (Chapman)

(Pl. XVI, fig. 6)

Pachypora alterivalis Chapman 1914, p. 309, Pl. 57, fig. 28-29.
Thamnopora alterivalis (Chapman) Hill 1950, p. 152-3, Pl. 8, fig. 28a-b.

DESCRIPTION: Corallum digitate, cylindrical, 8 mm in diameter or slightly greater, largest specimen 30 mm long.

Corallites usually 6-sided and polygonal but rounded by thickening of walls, fairly uniform in size, attaining 0·6 mm in diameter axially, and increasing to as much as 0·8 mm distally. Corallites expanding gently from the axial region and sharply inflected near the surface of the corallum to emerge normal to the surface; zone normal to the surface up to 1·5 mm wide. Walls usually less than 0·2 mm in width in axial regions, expanding to 0·4 mm distally, with thick primary walls and irregular intermural spaces.

Tabulae thick, flat to strongly curved, usually inclined, spacing averaging about 1 mm apart in axial region, more crowded distally where 8 may be present in a distance of 3 mm.

Mural pores circular, averaging 0·2 mm in diameter, about 0·8 mm apart and situated toward the centre of the corallite faces.

Septal spines absent.

FIGURED SPECIMEN: T.1081, Loc. 27, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 16 (rare), 27 (occasional), Limestone Phase, Coopers Creek Formation.

REMARKS: There can be little doubt that the specimens described here as *T. alterivalis* are conspecific with Chapman's species. However, the corallum is in general somewhat larger than in the type specimen and the material described by Hill (1950) from the Middle Devonian of Buchan. Hill has pointed to the very close comparison which can be drawn between *T. alterivalis* and *T. reticulata* (de Blainville) from the Middle and Upper Devonian of Europe. The only apparent difference between these species is that *T. alterivalis* possesses slightly smaller corallites and very slightly more distant mural pores.

One specimen from Loc. 27 agrees completely with the characters of *T. alterivalis* except that no tabulae are present. Smith (1945, p. 61) has noted, however, that 'specimens of *Thamnopora* are often found in which the tabulae have perished'.

Thamnopora boloniensis (Gosselet)

(Pl. XVI, fig. 2-4)

Madreporites cristatus Blumenbach 1803, p. 25-6, Pl. 3, fig. 12.
Favosites dubia Edwards and Haime 1851, p. 243-4.
Favosites boloniensis Gosselet 1877, p. 271.
Thamnopora boloniensis (Gosselet) Lecompte 1939, p. 122-8, Pl. 17; Pl. 18, fig. 1-6; Kropfitsch and Schouppé 1953, p. 91-5, fig. 1 (*cum syn.*); Hill 1954a, p. 30-31, Pl. 2, fig. 16-18; Stasinska 1958, p. 198-200, Pl. 9-11.

DESCRIPTION: Corallum digitate, cylindrical, dichotomously branching, 9 to 10 mm in diameter, largest collected about 6 cm long.

Corallites basically polygonal but strongly thickened, so the calices are rounded; not uniform in size but up to 1 mm in diameter axially and attaining 2·4 mm in diameter distally. Corallites gently curving from the axial region to open at about an angle of 45° to the surface of the corallum. Walls with strongly developed primary walls, thickened to reach a diameter of 0·2 mm or more in the axial region and expanding gradually to reach a diameter of 0·8 mm distally.

Tabulae thin, straight, usually inclined, as close as 0·6 mm apart, usually about 5 per cm, apparently confined to the axial region. Mural pores circular to ovate with longest dimension parallel to the growth direction of the corallites; when circular averaging about 0·22 mm but as small as 0·16 mm in diameter, arranged in an irregular series toward the middle of the faces of the corallites, as close as 0·6 mm, but usually about 0·9 mm apart.

Septal spines absent.

FIGURED SPECIMENS AND OCCURRENCE: T.1067-8 from M.3010, Loc. 11, Limestone Phase, Coopers Creek Formation (occasional); T.1073, Loc. 51, Boola Beds (rare).

REMARKS: The specimens from Tyers differ in no essential feature from the descriptions of this species given by Lecompte (1939), Schouppé (1953) and Stasinska (1958). The only slight differences which could be pointed to are firstly, that the tabulae are less frequent and more regular in the Tyers form and secondly, that the walls are slightly more thickened distally. In regard to this last point it should be noted that the single specimen from the mudstone facies of the Boola Beds shows greater thickening of the walls than do the limestone specimens. *T. boloniensis* ranges from lower Middle Devonian through into the Upper Devonian in various parts of Europe. It has also been described from the Devonian of Western Australia by Hill (1954a).

Among Eastern Australian species *T. boloniensis* perhaps resembles most closely the Middle Devonian *T. tumulosa* Hill 1950, a species which possesses, however, low septal ridges in the calices, as well as occasional septal spines. As *T. tumulosa* also shows dilation of the walls throughout the corallum, it is intermediate between *Thamnopora* and *Striatopora*, similar to the Silurian species *T. vaigacensis* Chernyshev 1938.

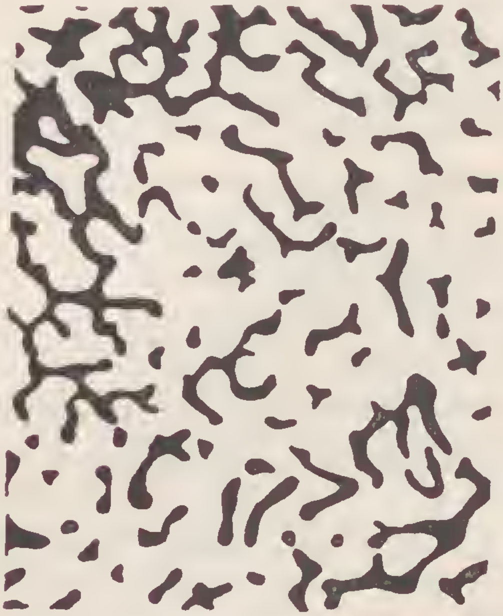

FIG. 2—*Natalophyllum callidum* sp. nov. Figure showing the shape of the corallites in the distally thickened portion of the corallum; walls white. From a polished section of the holotype M. 3015. x 15.

Genus **Natalophyllum** Raduguin 1938

(= *Plagiopora* Gürich 1896 = *Scoliopora* Lang, Smith & Thomas 1940)

Natalophyllum callidum sp. nov.

(Pl. XVI, fig. 1, 5; Fig. 2)

? *Thamnopora* sp. Hill 1954b, p. 114, Pl. 9, fig. 27a-c.

DIAGNOSIS: *Natalophyllum* with a generally digitate corallum about 1 cm in diameter; corallites averaging 0·25 mm in diameter axially with walls 0·08 mm thick, strongly meandroid distally with walls thickened to 0·3 mm; tabulae strong, about 8 per cm; mural pores ovate to circular, about 0·12 mm in diameter, spaced about 0·9 mm apart axially, averaging 0·4 mm apart distally. Septal spines absent.

Description: Corallum usually cylindrical, digitate, about 1 cm in diameter, largest in collection 4 cm long. One specimen with sub-pyriform corallum 2·5 cm high and 2 cm wide.

Corallites axially sub-rounded to slightly meandroid, fairly uniform in size, averaging 0·25 mm in diameter but reaching up to 0·4 mm. In digitate coralla the corallites bend sharply on leaving the axial zone and are normal to the surface of the corallum for a considerable distance before reaching it. In the sub-pyriform corallum the corallites diverge gently from a poorly defined axial region without the sharp change of growth direction. Distally corallites strongly meandroid with lumen diameter approximately 0·15 mm by as much as 0·6 mm; the meandroid shape probably due to the large mural pores which connect the corallites and so appear as channels through the thickened stereome of the walls. Wall thickness averaging 0·08 mm in axial region, expanding to 0·3 mm distally.

Tabulae strong, flat, horizontal or inclined, in places concave or strongly curved, irregularly spaced, as close as 0·15 mm, usually about 8 per cm but often less. Mural pores strongly ovate to almost circular, as large as 0·2 mm by 0·1 mm in the ovate pores where the longest dimension is parallel to the growth direction, more circular pores averaging 0·12 mm in diameter, in axial region as close as 0·6 mm apart but averaging 0·9 mm, distally closer averaging about 0·4 mm apart; in a single series at the centre of the corallite faces.

Septal spines absent.

Type and Figured Specimens: Holotype M.3011, T.1074-5, Loc. 20; T.830, Loc. 15, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 15 (rare), 20 (occasional), Limestone Phase, Coopers Creek Formation.

Remarks: In placing this species in the genus *Natalophyllum* Raduguin 1938 I have relied entirely on Sokolov's (1955) interpretation of the genus as Raduguin's original description is unavailable to me. *N. callidum* is very close to the species *N. huangi* Sokolov 1955 (Pl. 37, fig. 1-3); the only differences at all apparent are the smaller corallite diameter and larger mural pores of *N. callidum*. The genus *Natalophyllum*, as employed by Sokolov, clearly is extremely close to *Alveolites denticulatus* Edwards and Haime, the type species of *Scoliopora* Lang, Smith and Thomas 1940. Sokolov (p. 192) gives as the features by which the genera may be distinguished the thicker walls in the axial zone of *Natalophyllum* which show 'wall seams' (as do also Lecompte's (1939), Pl. 20, fig. 2, 3 of *Scoliopora denticulata*), the larger mural pores of *Scoliopora* and its better developed septal spines. As it appears neither useful nor even practicable to separate the two genera, it follows that *Natalophyllum* should replace the generic name *Scoliopora* which was proposed to replace the homonym *Plagiopora* Gürich 1896.

The holotype of *N. callidum*, in common with other species of *Natalophyllum*, possesses a digitate corallum, with sharp inflection of the corallites as they leave the axial zone, distal thickening of the corallite walls and the meandroid appearance of the corallites towards the surface of the corallum. Another specimen (Pl. XVI, fig. 5), although agreeing in all respects with the internal measurements of the holotype, has a sub-pyriform corallum in which the corallites are gently expanding. This suggests that the shape and growth of the corallum was variable in *N. callidum*.

Besides the growth of the corallum, the other feature which is usually regarded as a generic character in *Natalophyllum* is the meandroid appearance of the corallites toward the surface of the corallum. This, at least in *N. callidum*, is due to an abundance of comparatively large mural pores in the distal regions, so that tunnels are formed through the stereome of the thickened corallite walls of diameter comparable with that of the lumen diameter. I would regard the wall structure of greater taxonomic importance than the features mentioned above. As far as can be said from the illustrations of various species of *Natalophyllum*, the primary corallite walls are well developed in the axial region but are not at all apparent in the distally thickened portions of the corallum. This type of wall structure allies the genus to *Coenites* and quickly distinguishes it from *Thamnopora*.

Hill (1954b) has described a specimen from the Bell Point Limestone, Waratah Bay, in all probability conspecific with *N. callidum*. In that specimen Hill has taken the channels connecting the corallites in the distally thickened portions of the corallum to be possibly the work of boring organisms. Here they are regarded as mural pores.

Genus **Coenites** Eichwald 1829

Cladopora Hall 1851 has generally been regarded as a synonym of *Coenites* Eichwald 1829 [Hennig 1906; Smith 1933 (*fide* Lecompte 1939, p. 76); Hill and Stumm 1956]. Certain recent authors have maintained that *Cladopora* is a discrete genus (Lecompte 1936, 1952; Stumm 1949; Sokolov 1955; Stasinska 1958). The basis for this remains obscure as there is a whole gradation of species between those clearly allied to *Cladopora seriata* Hall and those comparable with *Coenites juniperinus* Eichwald, including species with foliar coralla not closely comparable to either type species. However, in the description of this fauna, it is convenient to distinguish between such species on the basis of the shape of the calices and for this reason *Cladopora* Hall is regarded as a subgenus of *Coenites*. This in no way is meant to imply any belief that the two are generically separate; the name is used merely as a morphological subgenus. It could be that *Cladopora* could be usefully used as a genomorph of *Coenites*, but it has yet to be established that the differences, primarily in the shape of the calices, may be developed in different lineages of *Coenites*. Sokolov (1955) and Stasinska (1958) go as far as to place *Cladopora* in the 'sub-order' Thamnoporina and *Coenites* in the 'sub-order' Alveolitina on the basis of the shape of the calices, a procedure which further highlights the artificial nature of Sokolov's classification.

Mention should be made of the Australian genus *Vetofistula* Etheridge 1917 based on *Vetofistula mirabilis* Etheridge 1917 from the Middle Devonian of Reid's Gap, Queensland. This genus was described by Etheridge as a bryozoan of uncertain affinities, but undoubtedly is based on a species of *Cladopora*.

Subgenus **Coenites** Eichwald 1829

Diagnosis: Corallum digitate to laminar or massive in which case it is built up of successive layers. Sharply defined axial or median zone of the corallum in which the walls ot the corallites are but slightly thickened and in which tho primary walls of the corallites may sometimes be visible. Away from the median zone the walls become strongly thickened and the primary walls no longer discernible. Calices alveolitoid. Mural pores and tabulae usually rare. Septa occasionally present in the calices.

Coenites (Coenites) planifolium sp. nov.

(Pl. XVII, fig. 1-4; Pl. XXI, fig. 2)

DIAGNOSIS: *Coenites* with thin, flat coralla averaging less than 2 mm in thickness with well developed median zone of slightly thickened corallites averaging 0·2 mm in diameter, and diverging from the median zone at an angle of 30°. Walls increasing to 0·8 mm thick at the surface where the calices are narrow and slit-like, up to 0·5 mm wide and strongly crescent-shaped. Tabulae irregularly developed; mural pores 0·8 mm in diameter; septal apparatus lacking.

DESCRIPTION: Corallum foliar, forming thin sheets up to 5 cm in longest direction, averaging 2 mm thick, in places reaching 4 mm, usually flat, sometimes slightly flexed; with well developed median zone of small, thin-walled corallites, 2 to 3 corallites thick, and from which the corallites diverge outwards to both surfaces of the corallum.

Corallites medially small, fairly uniform in diameter, typically rounded with slight thickening of the walls, averaging slightly less than 0·2 mm in diameter with walls of 0·04 mm thick. Corallites diverge sharply from the median zone at an angle of 30° to it, and this growth direction is maintained till the corallites emerge. In these longitudinal sections the lumen diameter decreases slowly from the median region as the corallites become progressively more crescent-shaped. Walls increasing to 0·8 mm thick distally with no primary walls present although the stereome is fibrous with a marked preferred orientation of the calcite fibres. At the surface the calices are strongly crescent-shaped, as much as 0·5 mm wide and less than 0·1 mm high.

Tabulae irregularly developed, apparently absent in places, thin, flat and normal to growth direction of the corallites. Mural pores circular to slightly ovate, averaging 0·08 mm in diameter and usually about 0·7 mm apart, but fairly irregularly spaced; tabulae and mural pores confined to median zone of corallum.

Septal apparatus absent.

TYPE AND FIGURED SPECIMENS: Holotype T.1085-9; T.1090; T.1091; Loc. 48; M.3044, Loc. 47, Boola Beds.

OCCURRENCE: Loc. 47 (occasional), 48 (common), 49 (occasional), Boola Beds.

REMARKS: This species resembles most closely the Lower and Middle Devonian *Coenites escharoides* (Steininger) from which, however, it differs in a number of respects. The corallum, in general, is slightly thinner, the corallites slightly smaller and open at an angle of 30° to the surface of the corallum, the mural pores are larger and the tabulae more irregularly developed. Moreover, the calices are very much wider in *C. planifolium*. As these differences are consistent, it is best to regard this form as a new species.

Coenites expansus de Koninck (*non* Frech) from the Middle Devonian of Murrumbidgee and Buchan differs from this species in possessing a much heavier corallum and larger corallites. Thus the mould illustrated by Etheridge (1899b) as *Coenites* sp. from the Lower Devonian of Sandy's Creek, Tabberabbera, resembles more closely *C. expansus* than *C. planifolium*.

C. planifolium is confined to the mudstone facies of the Boola Beds, where it occurs very often as moulds.

Subgenus **Cladopora** Hall 1851

DIAGNOSIS: *Coenites* in which the calices are round or ovate rather than alveolitoid.

Coenites (Cladopora) foliata (Jones)

(Pl. XVII, fig. 5-6; Pl. XVIII, fig. 2)

Pachypora meridionalis Richards and Bryan 1924, Pl. 16, fig. 2.
Thamnopora foliata Jones 1941, p. 48-9, Pl. 2, fig. 1-3.

DESCRIPTION: Corallum foliar or encrusting, up to 6 mm wide, irregular in thickness, averaging about 4 mm, with corallites opening on both surfaces of corallum. Occasionally massive or cylindrical, in which case made up of growth layers about 2·5 mm thick, and the corallites then arise from a thin layer of slightly thickened corallites at the base of each layer. Largest such corallum 15 mm thick. Corallites in this basal layer or usually median layer rounded ovate or subpolygonal averaging 0·25 mm in diameter with wall diameter 0·03 mm, with 2, 3 or 4 layers of corallites in this slightly thickened zone. Corallites usually bending sharply after leaving this zone to emerge usually normal to the surface of the corallum; calices circular to slightly ovate, usually about 0·2 mm in diameter, fairly constant in diameter in parts of a corallum, but occasionally reaching up to 0·3 mm. Thickness of wall between adjacent corallites up to 0·3 mm but averaging 0·25 mm.

Tabulae occasionally seen; thin, flat or slightly convex and normal to the growth direction of the corallites. Mural pores rarely encountered, about 0·07 mm in diameter. Tabulae and mural pores apparently confined to the median zone of the corallum.

Septal apparatus absent.

FIGURED SPECIMENS: T. 1095, T. 1100, Loc. 11; T. 1099, Loc. 19, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 11 (occasional), 19 (rare), 20 (rare), 27 (common), Limestone Phase, Coopers Creek Formation.

REMARKS: Jones (1941), in describing this species from the Middle Devonian of Clermont, Queensland, commented on the difficulty of classifying this species at the generic level. Here it has been moved to the genus *Coenites* on the basis of the growth form of the corallum and the wall structure (i.e. the absence of any trace of the primary walls of the corallites in the dilated distal zone). It is included in that morphological section of the genus covered by the subgenus *Cladopora* on the basis of the rounded calices.

The Tyers material differs from Jones's description of this species in only one point and that is the size of the corallites at the surface of the corallum. These are larger in the Clermont form where the lumen is said to be about 0·35 mm in diameter. On the other hand the present material averages 0·2 mm in lumen diameter, although in places it may be as much as 0·3 mm.

Coenites (Cladopora) gippslandica (Chapman)

(Pl. XVIII, fig. 1, 3-7)

Rhombopora gippslandica Chapman 1907, p. 78, Pl. 2, fig. 4; Pl. 7, fig. 15.
? *Acanthoclema flexuosa* Chapman 1920, p. 189, Pl. 24, fig. 20; Pl. 32, fig. 38-40; Gill 1949, p. 94.

DESCRIPTION: Corallum digitate, cylindrical to ovate in cross-section, between 2 mm and 8 mm in diameter, usually about 3 mm, with largest corallum collected 5 cm in length, but probably greatly in excess of this. Corallum often branched and flexed.

Corallum with axial zone of slightly thickened corallites averaging between 0·15 and 0·24 mm in different coralla, with 3 to 12 corallites in contact through this axial region. Walls in this zone as little as 0 02 mm in diameter, but up to 0·1 mm in some specimens in which case they are probably thickened by an irregular layer of secondary calcite. Primary walls of corallites visible in axial region. Corallites leaving axial zone with abrupt change in direction of growth, then curving slightly away from the axial zone to emerge at an angle of about 40° to the surface of the corallum. Lumen diameter fairly constant throughout, with walls thickened gradually toward the surface of the corallum where they reach a thickness of about 0·3 mm between adjacent corallites, but may be as little as 0·1 mm. Calices rounded or slightly elongate and aligned in fairly regular vertical series.

Tabulae not observed. Mural pores only occasionally seen, apparently confined to the axial zone of the corallum where they occur toward the centre of the corallite faces, about 0·08 mm in diameter, irregularly spaced, although in certain coralla fairly constant where they average as close as 0·5 mm apart.

Septal apparatus absent.

FIGURED SPECIMENS: M.3014 — T.1109, 1110, Loc. 11, Limestone Phase, Coopers Creek Formation; T.1111-4, Loc. 48, Boola Beds.

OCCURRENCE: Loc. 1 (rare), 4 (rare), 11 (common), 15 (occasional), 16 (rare), 18 (rare), 19 (rare), 20 (occasional), 21 (rare), 22 (rare), 26 (rare), 27 (common), Limestone Phase, Coopers Creek Formation; Loc. 35 (rare), 36 (rare), Conglomerate Phase, Coopers Creek Formation; Loc. 40 (rare), 43 (rare), 47 (occasional), 48 (common), 49 (occasional), Boola Beds.

REMARKS: This species proved to be particularly variable in the size of the corallum. In specimens from the mudstone facies of the Boola Beds the coralla are generally thinner perhaps also with less distal thickening of the walls, whereas in the overlying limestone facies they tend to be larger and stronger. Even so, no satisfactory subdivision of the species could be achieved, as specimens identical with the mudstone form are present among specimens from the limestone. As the internal features of all the specimens examined are fairly constant, and as there is a continuous range of variation in the size of the corallum, it is best to regard the specimens as representatives of one variable species.

Coenites (*Cladopora*) *gippslandica* belongs to a group of species allied to *Cladopora seriata* Hall 1852, the Middle Silurian type species of the genus. This species group includes the North American Middle Devonian *Cladopora bifurcata* Grabau (1910, p. 115, Pl. 10, fig. 2-4; Pl. 12, fig. 7-8; Pl. 15, fig. 1), *Cladopora gracilis* (Saleé 1915, MS.) (Lecompte 1939, p. 78-80, Pl. 12, fig. 6-10; Stasinska 1958, p. 195-6, Pl. 7) from the Middle and Upper Devonian of Europe and *Coenites declivis* Weissermel (1939, p. 70-2, Pl. 6, fig. 4-6) from the Coblenzian of Bosporus. Of these *C.* (*Cladopora*) *gippslandica* is perhaps closest to *Coenites declivis* Weissermel from which it differs in possessing a generally smaller corallum and larger corallites. Close comparison with many of the North American species of similar dimensions is difficult, as their internal structure is often undescribed.

Acanthoclema flexuosa Chapman 1920, based on moulds from the Silurian of the Wombat Cr. area in NE. Victoria, and recorded by Gill (1949) from the Lower Devonian of Sandy's Cr., Tabberabbera, is in all probability a synonym of *C.* (*Cladopora*) *gippslandica*, which is also recorded by Chapman (1907) from mudstone in the Wombat Cr. area.

Certain Australian species described in the genus *Thamnopora* (e.g. *Thamnopora meridionalis* var. *minor* Jones 1941 from the Middle Devonian of Clermont and *T. angulata* Hill 1950 from the Middle Devonian of Buchan) resemble *C. gippslandica* in the sizes of the corallum and the corallites, and could also be species of *Cladopora*.

Genus **Fossopora** Etheridge 1903

Fossopora quintaria sp. nov.

(Pl. XX, fig. 1-2)

DIAGNOSIS: Corallum discoidal; corallites averaging 0·5 mm with thick, amalgamated walls averaging 0·2 mm thick, with 5 strong lamellar septa extending over half way to the axis. Tabulae thin, fairly regularly spaced, between 16 and 20 per cm, in places developed at similar heights in adjacent corallites. Mural pores ovate, averaging about 0·16 mm in diameter, uniserial or irregularly biserial, averaging 0·7 mm apart.

DESCRIPTION: Corallum discoidal (largest in collection fragmentary, 50 mm in diameter and averaging 10 mm thick) or laminated with growth layers about 7 mm thick with basal zone on undilated corallites parallel to base of corallum.

Corallites within the corallum parallel, averaging 0·5 mm in diameter, with thick walls, typically with 5 strong lamellar septa obscuring the shape of the lumen. Walls averaging 0·2 mm thick but highly variable, between 0·1 mm and 0·4 mm, amalgamate, without primary corallite walls.

Tabulae thin, straight, occasionally incomplete or inosculating, fairly regularly spaced between 16 and 20 per cm, in places developed at the same height in adjacent corallites. Mural pores ovate to circular, averaging 0·18 mm by 0·14 mm with largest dimension parallel to growth direction, apparent in transverse sections as tunnels through the thick walls and developed in an irregular series toward the centres of the corallite faces between the septa, up to 1 mm apart, but averaging about 0·7 mm, occasionally irregularly biserial alternate. Pore plates usually present.

Septa of long thick lamellar projections extending over halfway into the centre of the lumen, constant in width with rounded ends, only rarely acanthine along their free edges. 5 septa present in adult corallites but in smaller corallites 4 or even 3 poorly developed septa present.

TYPE AND FIGURED SPECIMEN: Holotype M.3015 — T.1124-5, Loc. 11, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 11 (occasional), 19 (rare), 21 (rare), 27 (occasional), Limestone Phase, Coopers Creek Formation.

REMARKS: Lafuste (1958) showed that mural pores are absent in *Thecia swinderniana* (Goldf.) and so removed this genus and its synonym *Romingella* Amsden 1949 from the Favositidae. Thus there are left the following closely related favositid genera with lamellar septa, all of which are based on, in all likelihood, Silurian type species:

Laceripora Eichwald 1854, type species *L. cribosa* Eich., from the Silurian (?) of Estonia.

Somphopora Lindström 1883, type species *S. daedalea* Lind., from the Silurian of China.

Fossopora Etheridge 1903, type species *F. wellingtonensis* Eth., from the Silurian (?) of N.S.W.

Boreaster Lambe 1906, type species *B. lowi* Lambe, from the Silurian of Arctic Canada.

Angopora Jones 1936 (*pro Laminopora* Jones 1930), type species *A. hisingeri* Jones, from the Silurian of Gotland.

Stable generic characters are extremely difficult to assess in this group, particularly as most of these genera have remained monotypic since their proposal.

There can be little doubt that at least *Fossopora* and *Boreaster* are synonymous, and that many of the species with mural pores originally described in the genus *Thecia* should be transferred to the genus *Angopora* Jones. The new species is placed in the genus *Fossopora* Eth. because of its general similarity to *F. wellingtonensis* although it differs from this species in that the septa only rarely become spinose along their free edges and the tabulae may be at the same height in adjacent corallites. Furthermore the septa are but 5 in number in adult corallites. It seems best at present to expand the genus *Fossopora* to include this species rather than propose a new genus for its reception.

Comparison can be drawn between *F. quintaria* and certain species described in the genus *Thecia* (e.g. *Thecia devonica* Charlesworth 1914, p. 381-2, Pl. 34, fig. 11, from the Lower Devonian of the Carnic Alps, and *Thecia minimorum* Barrande, Počta 1902, p. 278, Pl. 93, 114, from the Koněprus), but from these and related species *F. quintaria* differs in the possession of 5 septa.

The fine structure of the skeleton of *F. quintaria* is virtually identical with that of *Thecia swinderniana* (Goldf.) described by Lafuste (1958) as being trabecular. The walls consist of well developed calcite fibres directed upwards and outwards from the median plane which consists of a zone of usually clearer calcite. The fine structure of the septa is similar, with fibres again radiating from a median zone. The walls are amalgamated, with no trace of primary corallite walls, and carbonaceous matter is often incorporated in them. The structure of the septa is thus comparable with the monacanthine septa of rugose and scleractinian corals, in as much as each septum can be regarded as consisting of a single, flattened trabecula. No marked distinction can be drawn between this type of wall structure and that of *Favosites* as has been suggested by Lafuste (1958). In *Favosites* one finds that the slightly felted fibres of the peripheral stereozone are again radiating upwards, although usually this is not so apparent as in *F. quintaria*. In the case of *Favosites* the fibres radiate from the thin, primary walls of the corallites. As the septal apparatus, both squamulae and septal spines, is trabeculate in favositids (Kraicz 1937; Hill 1950; Hill and Stumm 1956) the only real distinction which can be drawn is in the absence of primary walls in *Thecia swinderniana* and *F. quintaria*. However in certain genera of the Favositidae (e.g. *Coenites*) the primary walls of the corallites may be visible in unthickened portions of a corallum, where the walls are slightly thickened, but are absent in the distally dilated walls.

Genus **Pleurodictyum** Goldfuss 1829

Pleurodictyum megastoma McCoy

(Pl. XXI, fig. 1, 6)

Pleuradicitynis migostoma McCoy 1866, p. 34.
Pleurodicityun megastoma McCoy 1867, p. 23.
Pleurodictyum megastoma McCoy 1867b, p. 201.
Pleurodictyum megastomum McCoy, Etheridge 1878, p. 13.
Pleurodictyum ? problematicum Goldf., Foerste 1888, p. 132-5, Pl. 13, fig. 22.
Pleurodictyum sp. (? *P. megastomum* McCoy MS.) Dun 1898, p. 83-5, Pl. 3, fig. 1.
Pleurodictyum megastomum Dun, Chapman 1903a, p. 105, Pl. 16, fig. 2-5; Chapman 1908, p. 222; Chapman 1914b, p. 111, Fig. 69e; Chapman 1921, p. 216, Pl. 9, fig. 4-6; Allan 1929, p. 322; Withers 1932, p. 15-19, Fig. 1-6; Shirley 1938, p. 463-4, Pl. 60, fig. 5-8; Gill 1942, p. 35-6, Pl. 4, fig. 1, 3, 4, 6, 9.
Pleurodictyum megastomum McCoy, Hill 1942b, p. 8, Pl. 2, fig. 5.
Pleurodictyum megastomum Dun, Gill 1948, p. 66, Pl. 8, fig. 13; Gill 1950, p. 241.
Pleurodictyum megastomum McCoy, Bassler 1950, p. 128.

Description: (Based on moulds.) Corallum flat, discoidal, up to 2 cm in diameter with well developed basal epitheca showing irregular concentric growth lamellae.

Corallites with calices up to 4 mm in depth and up to 7 mm in diameter, usually averaging 5 mm, fairly constant within the one corallum with up to 9 corallites in the one corallum. Walls of the order of 0·5 mm or thicker.

Apparently few tabulae present, surfaces covered by short, upwardly directed spines which continue without interruption on to the corallite walls to form the septal spines of the calices where they may become aligned on very low septal ridges about 0·8 mm apart. Spines usually stronger on the surface of the tabulae. Mural pores less than 0·2 mm in diameter, randomly disposed on the corallite faces, about 0·5 mm apart, often obscuring the low septal ridges.

Figured Specimens: M.3013, Loc. 36, Conglomerate Phase, Coopers Creek Formation; M.3012, Loc. 43, Boola Beds.

Occurrence: Loc. 35 (rare), 36 (rare), Conglomerate Phase, Coopers Creek Formation; Loc. 43 (rare), 47 (occasional), 49 (occasional), Boola Beds.

Remarks: The original description of McCoy (published three times), although merely referring to the size of the corallites, is sufficient to characterize this species. As the first two spellings of the specific clearly represent *lapsi calami* the trivial name should be rendered *megastoma*, as Etheridge's (1878) emendation of the spelling is invalid.

From the synonymy it can be seen that *P. megastoma* has been recorded and described more often than any other Victorian Silurian and Devonian species. Because of its widespread occurrence, an attempt was made to subdivide this species on the basis of the size of corallites. However, the material available was found insufficient to characterize adequately the variation between different specimens from the one horizon. All that can be said at this stage is that there appears to be a certain increase in size and variability of the corallite diameter in specimens from younger horizons in the Yeringian. Thus specimens from Kinglake may show an average corallite diameter of up to 14 mm, whereas the specimens illustrated by Gill (1948, 1950) from Tasmania have an average corallite diameter of less than 5 mm.

Although the material from Tyers has only specimens with 3 to 9 corallites present in a corallum, as many as 28 have been recorded in *P. megastoma* (Gill 1942).

Among overseas species *P. megastoma* is perhaps most closely allied to the Coblenzian *P. constantinopolitanum* Roemer (1863, p. 519, Pl. 5, fig. 1) from Bosporus which Weissermel (1939) has considered to be possibly synonymous with *P. giganteum* Kayser (1889, p. 295) from the Lower Devonian of the Rheinischer Schiefergebirge. Shirley (1938) also points to the similarity between *P. megastoma* and *P. petrii* Maurer and the closely related *P. hunsruckianum* Fuchs. *Pleurodictyum nodai* Yabe and Sugiyama 1942 (p. 499-500, Fig. 1a-b) is a Japanese species also difficult to distinguish from *P. megastoma*.

P. megastoma is at present taken as sure indication of the Devonian age of the rocks in which it occurs. Certainly the genus is restricted to the Devonian of Europe where it first appears in the Upper Gedinnian (Asselberghs 1946). However in North America, Amsden (1949) has described *P. tennesseensis* from the Brownsport Formation of Niagaran age. This species is not unlike the smaller celled varieties of *P. megastoma*.

Family HELIOLITIDAE Lindström

Genus **Heliolites** Dana 1846

Heliolites daintreei Nicholson and Etheridge

(Pl. XVII, fig. 7; Pl. XIX, fig. 1-4)

Heliolites Daintreei Nicholson and Etheridge 1879, p. 224, Pl. 14, fig. 3-3a.
Heliolites barrandei Pen. var. *turcica* Weissermel 1939, p. 88-91, Pl. 9, fig. 4; Pl. 10, fig. 1-3.
Heliolites daintreei Nicholson and Etheridge, Jones and Hill 1940, p. 199-203, Pl. 6, fig. 1-5; Pl. 7, fig. 1-5; Pl. 8, fig. 1-8; Pl. 9, fig. 1 (*cum syn.*); Jones 1944, p. 37-8, Pl. 1, fig. 9-10.
Heliolites regularis Dun var. *kusnetskiensis* Chernyshev 1951, p. 89-90, Pl. 22, fig. 6-7.
Heliolites tomensis Chernyshev 1951, p. 90-1, Pl. 23, fig. 1-2.
Heliolites insolens Chernyshev 1951, p. 91-2, Pl. 23, fig. 3.
Heliolites daintreei Nicholson and Etheridge, Hill 1954b, p. 115, Pl. 9, fig. 30.
Heliolites Barrandei Penecke, Fontaine 1954, p. 68-70, Pl. 8, fig. 5-9.

DIAGNOSIS: (After Jones and Hill 1940.) Corallum sub-hemispherical, tabularia between 0·5 and 2 mm in diameter, consistent within the one corallum, up to 6 mm apart, separated by sub-polygonal coenenchymal tubes about 0·3 mm in diameter. Tabularia with 12 variably developed lamellar septa forming upwardly developed spines which may extend into the centres of the tabularia.

DESCRIPTION OF TYERS MATERIAL: Corallum hemispherical, largest in collection 13 cm in diameter.

Tabularia parallel or slightly expanding, rounded or with slightly crenulate walls, averaging between 0·8 and 1·7 mm in diameter in different coralla, consistent within the one corallum, regularly spaced, averaging between 0·3 and 0·8 mm apart, separated by coenenchymal tubes averaging between 0·25 and 0·35 mm in diameter, usually 6-sided with rounded corners. Walls averaging 0·04 mm, thickened to 0·1 mm around the tabularia. Occasionally walls of coenenchymal tubes thickened also.

Tabulae within the tabularia thin, usually horizontal, occasionally inclined, incomplete or inosculating, between 15 and 34 per cm. Sola within the coenenchymal tubes 19 to 40 per cm.

Septa within the tabularia variably developed, 12 in number, laminar, giving rise to strong, upwardly curved, septal spines along the free edge. In certain sections however septa virtually absent. Where walls crenulate, septa developed on the angles which protrude into tabularium.

FIGURED SPECIMENS: T.1131, Loc. 11; T.1133-4, Loc. 20; T.1135-6, Loc. 19, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 7 (rare), 11 (common), 15 (rare), 19 (rare), 20 (rare), 22 (rare), 27 (occasional), Limestone Phase; Loc. 33 (occasional), Conglomerate Phase, Coopers Creek Formation; Loc. 48 (rare), 49 (rare), Boola Beds.

REMARKS: Jones and Hill (1940), in a revision of the Heliolitidae of Australia, interpreted the widespread Silurian and Devonian *H. daintreei* as a particularly variable species, and, from the extensive collections at their disposal, were merely able to recognize four ill-defined groups within the species. They concluded that *H. barrandei* Pen., as interpreted by Lindström (1899) is conspecific with *H. daintreei* and regarded four of Dun's (1927) species from Yass, as well as two of Kettnerova's (1933a, b) species from the Koněprus as synonyms or possible synonyms of *H. daintreei*. Chernyshev (1951), in describing the Silurian and Devonian Heliolitidae from the Kuznetsk Basin, has added at least three more names to the synonymy of this species. Furthermore his *Heliolites vulgaris* and its two varieties are further possible synonyms of *H. daintreei* although Chernyshev states in each case that septa are absent.

The specimens from Tyers fall within the range of variation of Jones and Hill's 'Group IV'. The specimens from the mudstone facies of the Boola Beds show smaller tabularia and more strongly developed septal apparatus than those from the limestone.

Genus **Plasmopora** Edwards and Haime 1849

Plasmopora gippslandica (Chapman)

(Pl. XIX, fig. 5-6)

Heliolites interstincta var. *gippslandica* Chapman 1914, p. 311, Pl. 9, fig. 35-6.
Plasmopora gippslandica (Chapman) Jones and Hill 1940, p. 206, 208, Pl. 10, fig. 5; Pl. 11, fig. 1.
Heliolites yavorskyi Chernyshev 1951, p. 98-9, Pl. 25, fig. 1-3.
Heliolites kvosčeviensis Zhmeav, *in* Halfina 1955, p. 205-6, Pl. 33, fig. 4a-b.

DESCRIPTION: Corallum hemispherical, largest in collection 5 cm in diameter.

Tabularia parallel or slightly radiating, averaging between 0·8 and 1 mm in diameter in different coralla, regularly spaced, averaging 0·5 mm apart, with usually 2 coenenchymal tubules between each tabularium, but from 1 to 4. Coenenchymal tubules polyhedral, averaging about 0·25 mm in diameter with continuous vertical walls, those of the aureole of 12 surrounding the tabularia not well differentiated, occasionally somewhat larger and more elongate radial to the tabularia. Walls averaging 0·04 mm in diameter increasing to 0·08 mm around the tabularium.

Tabulae within the tabularia, thin, flat, occasionally incomplete or inosculating, averaging about 34 per cm. Sola within coenenchymal tubes averaging 45 per cm.

No septal apparatus.

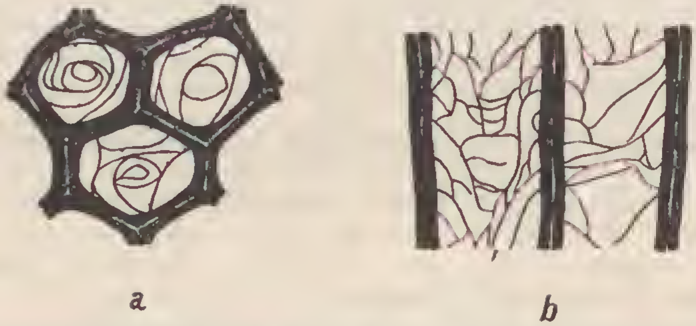

FIG. 3—*Roemeria thomii* (Chapman). (a) T.S., (b) L.S. Composite drawings showing the nature of the tabulae, based on portions of T. 1161-2 and M. 3013. x 4 approx.

FIGURED SPECIMEN: T.1056-7, from M.3017, Loc. 5, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 5 (rare), 11 (rare), Limestone Phase, Coopers Creek Formation; Loc. 43 (rare), 48 (rare), Boola Beds.

REMARKS: Hill and Jones (1940) give the diameter of the tabularia in this species as between 1 and 1·5 mm whereas the Tyers material shows an average tabularium diameter between 0·8 and 1 mm. There can be little doubt that the Tyers form is conspecific with *P. gippslandica* particularly as Chapman's original material came from the same horizon at Coopers Creek, just to the north.

Chernyshev's (1951) *Heliolites yavorskyi* from the Upper Silurian of the Kuznetsk Basin is undoubtedly conspecific with *P. gippslandica*; the only slight difference is that the tabularia are said to be between 0·7 and 0·8 mm in diameter in that species. *Heliolites kvosčeviensis* Zhmeav is a further Russian species of *Plasmopora* indistinguishable from *P. gippslandica*, while again *Plasmopora aseptata* Regnéll (1941, p. 50-2, Pl. 12, fig. 2-5), from the Siluro-Devonian of Tien-Shan, represents another identical or closely related species. The only apparent distinction between it and *P. gipplandica* lies in the coenenchymal tubules which are more often shared between neighbouring tabularia in Regnéll's species. Jones and Hill have already pointed to the close comparison which exists between *P. gipplandica* and the Middle Devonian *P. carnica* Vinassa de Regny 1918.

Family AULOPORIDAE Edwards and Haime

Genus **Roemeria** Edwards and Haime 1851

Roemeria thomii (Chapman)

(Pl. XX, fig. 3-4; Fig. 3)

Syringopora thomii Chapman 1921, p. 222-3, Pl. 10, fig. 14-16.

DESCRIPTION: Corallum hemispherical, up to 5 cm in diameter, partly cerioid. Corallites polygonal, 6-sided or in places cylindrical where the corallites are loosely united. Corallite diameter averaging 4·5 mm with common walls 0·6 mm in diameter.

Tabulae thin, crowded, long and steeply inclined, forming an irregular axial tube. Mural pores irregularly developed, about 0·5 mm in diameter. Small septal spines occasionally visible around the periphery of the lumen.

FIGURED SPECIMEN: T.1161-2 from M.3013, Loc. 22, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 21 (rare), 22 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: The two specimens in the collection are so poorly preserved that very little can be added to the brief description of this species given by Chapman (1921).

R. thomii is intermediate in corallite diameter between *R. progenitor* (Chapman 1921) from the Lilydale Limestone and *R. ocellata* Hill 1950 from the Middle Devonian of Buchan. It further differs from those species in possessing only poorly developed spines on the upper surfaces of the tabulae.

Genus **Aulopora** Goldfuss 1829

Aulopora sp. affin. **A. emergens** Quenstedt

(Pl. XX, fig. 5-6)

Affin. *Aulopora emergens* Quenstedt 1881, p. 103-4, Pl. 147.
Affin. *Aulopora emergens* Quenstedt, Kettner 1934, p. 7-11, Fig. 6-7.

DESCRIPTION: Corallum of loosely compacted tubes, often in contact, forming large masses up to 15 cm in diameter. Corallites cylindrical, up to 0·9 mm in diameter, averaging between 0·7 and 0·8 mm in different slides, as many as 6 in contact at the one height, flattened along the surfaces of contact. Peripheral stereozone varaible, up to 0·3 mm in diameter and as little as 0·1 mm, averaging about 0·2 mm.

Tabulae thin, irregular, in places horizontal or convex, sometimes steeply inclined and even simulating dissepiments, rarely infundibuliform, usually incomplete. Connecting processes between corallites absent but occasional breaks in walls present where the corallites are in contact.

Septal spines absent or extremely rudimentary.

Figured Specimen: T.1166-7, Loc. 11, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 11 (occasional), 15 (rare), 22 (rare), 27 (rare), Limestone Phase, Coopers Creek Formation.

Moulds from Loc. 47, Boola Beds, with similar corallite diameter, are doubtfully included in this species.

Remarks: The specimens from the limestone agree closely with the description of the species given by Kettner (1934), although the figures given suggest a form of slightly larger corallite diameter than the material from Tyers. Kettner's specimens, from the Devonian of Bohemia, possess similarly distributed tabulae and also occasional breaks in the corallite walls connecting the corallites where they are in contact. There can be little doubt that the Tyers material is very closely allied to Quenstedt's species, as interpreted by Kettner, although the thin sections of this form, taken from massive limestone, do not define adequately either its calices or mode of increase. *A.* cf. *conglomerata* Goldfuss of Hill (1950) from the Middle Devonian of Buchan is a species with similar corallite diameter.

Order Rugosa

Suborder Streptelasmatina

Family Laccophyllidae Grabau

Diagnosis: Comparatively small, solitary rugose corals with axial ends of major septa united at an aulos which divides a series of horizontal inner tabellae from an outer series of inclined tabellae; minor septa, when present, contratingent; dissepiments occasionally developed in the interseptal loculi, or rarely lonsdaleoid.

Remarks: Hill (1939), Stumm (1949b) and Hill (1956a) state in diagnosis of the family Laccophyllidae (= Syringaxonidae) that members of this family do not possess dissepiments. However, dissepiments have been described in species assigned to genera of this family. For example, Hill (1950) described as *Syringaxon radiatum* a species from the Middle Devonian of Buchan in which (p. 144) 'occasionally in the distal parts of the corallite a few dissepiments may be developed between one minor septum and its neighbouring major septum': Hill (1954a) has further described species of *Barrandeophyllum* which possess occasional dissepiments either between major and minor septa, or rarely lonsdaleoid dissepiments, causing discontinuity in the septa. *Catactotoechus* Hill 1954, a laccophyllid genus in which the minor septa are absent, possesses a single incomplete series of dissepiments, each connecting two major septa. Prantl (1938), followed by Schouppé (1951b, 1954a), have considered that dissepiments are present in *Barrandeophyllum perplexum* Počta, the type species of the genus *Barrandeophyllum* Počta 1902. Thus Schouppé (1951, 1954a) regarded the difference between *Syringaxon* and *Barrandeophyllum* to be that, in the latter genus, dissepiments can be seen in transverse sections between the septa forming interseptal 'Querverbindungen'. Rather than dissepiments these appear to be supplementary tabulae. In *Syringaxon* (*Saucrophyllum*) *pocillum* subgenus et sp. nov. dissepiments are consistently developed in a single vertical series in the interseptal loculi between the major and minor septa. Thus the family diagnosis given above has been modified to include forms with dissepiments.

Genus **Syringaxon** Lindström 1882

Following Schouppé (1951b, 1954a), *Barrandeophyllum* Počta 1902 is regarded as a subgenus of *Syringaxon.* The thickening of the septa and of the well formed aulos in species of *Syringaxon* do not appear to be characters of sufficient merit to justify the generic separation. Although usually present, minor septa may be absent in either subgenus. A further subgenus *Saucrophyllum* nov. is proposed in which a vertical series of dissepiments occurs between the major and minor septa. Wang (1950) has recognized *Duncanella* Nicholson 1874 as another subgenus of *Syringaxon* to include species in which the septa are entirely lamellar rather than medially trabeculate.

Subgenus **Syringaxon** Lindström

Syringaxon (Syringaxon) sp.

(Pl. XXII, fig. 9)

DESCRIPTION: Small, solitary, trochoid corals, round or ovate in transverse section, up to 6 mm in diameter and with height up to 1 cm; calyx about 5 mm deep in adult specimens. Epitheca with only faint growth striations.

Major septa about 20 in adult specimens with contratingent minor septa extending up to half way to the aulos and resting on all but the cardinal, counter and counter-lateral septa. Septa with only a very thin medial trabeculate zone, strongly thickened by lamellar stereome, often to the exclusion of the interseptal loculi between the contratingent septa which are uniform in thickness throughout their length. Aulos well developed, small, circular to strongly ovate in transverse section, with internal diameter between 0·5 and 1·2 mm, formed by the fitting together of the axial ends of the dilated major septa with the sutures between the septa usually visible.

Peripheral stereozone thin, about 0·2 mm in diameter. Tabulae few, those within the aulos horizontal. Dissepiments absent.

FIGURED SPECIMEN: T.1176, Loc. 50, Boola Beds.

OCCURRENCE: Loc. 40 (occasional), 43 (rare), 47 (occasional), 48 (occasional), 50 (occasional), Boola Beds.

REMARKS: The extreme thickening of the septa in this species, which is confined to the mudstone facies of the Boola Beds, serves to distinguish it from other North American and European species of *Syringaxon.* In this dilation of the septa it contrasts with the laccophyllids of the limestone facies of the Coopers Creek Formation. It is of interest to note that Prantl (1938) has mentioned that the amount of thickening within the Devonian species of *Syringaxon* from Bohemia is greater in species from shales than it is in species from limestone.

In size and number of septa the species is most closely allied to the Silurian *Syringaxon siluriensis* (McCoy) from which it differs in other respects apart from the dilation of the septa (e.g. the absence of counter-lateral minor septa). The ontogeny of the two species is apparently very different, for at a diameter of 1·4 mm our present species possesses a well formed aulos and 12 septa, whereas in *Syringaxon siluriensis* a poorly formed aulos first appears at a diameter of about 4 mm where most of the major septa have developed and the minor septa have appeared (*fide* Butler 1935).

The material to hand from the massive mudstones of the Boola Beds did not produce one longitudinal section which adequately defined the nature of the tabulae in this species. For this reason the species has not been named.

Moulds of species of *Syringaxon* are not uncommon in the Siluro-Devonian sequences of Lilydale and Kinglake, but positive identification of these is virtually impossible in the absence of hard parts.

Subgenus **Barrandeophyllum** Počta 1902

Syringaxon (Barrandeophyllum) sp.

(Pl. XXII, fig. 10)

Description: Small, solitary, trochoid corals up to 8 mm in diameter.

Major septa 18 in number at diameter of 4 mm increasing to 21 at a diameter of 8 mm. Minor septa absent. Aulos with internal diameter of about 1 mm or usually less, often poorly defined or with irregular thickening; cardinal septum may extend further into aulos than other septa. Septa moderately thick, fairly constant in diameter, averaging about 0·2 mm.

Peripheral stereozone up to 2 mm across. Tabulae abundant and inclined in outer series, apparently horizontal within the aulos.

Figured Specimen: T. 1184, Loc. 15, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 11 (rare), 15 (occasional), 20 (occasional), Limestone Phase; Loc. 28 (rare), Conglomerate Phase, Coopers Creek Formation.

Remarks: Because of the variable development of the aulos and the slightly thickened septa, this species is placed in the subgenus *Barrandeophyllum*. Again the material available does not adequately define this species. It could be that more than one species is represented among the 6 specimens here regarded as conspecific.

Syringaxon inopinata Prantl (1938, p. 312, Pl. 1, fig. 6; Fig. 3) from the Middle Devonian of Bohemia and *Barrandeophyllum rubrum* Hill (1939c, p. 142-3, Pl. 1, fig. 1, 2) from the Devonian of Western Australia are other species of *Syringaxon* which lack minor septa.

Subgenus **Saucrophyllum** subgenus nov.

Diagnosis: Comparatively large *Syringaxon* with a single row of inclined dissepiments consistently developed between the contratingent major and minor septa.

Type Species: *Syringaxon* (*Saucrophyllum*) *pocillum* sp. nov.

Remarks: It seems a worthwhile procedure to recognize a category within *Syringaxon* to include species in which dissepiments are present within the interseptal loculi. Schouppé (1951b, 1954a) has ascribed this feature to the subgenus *Barrandeophyllum* but it appears that in species of *Barrandeophyllum* the partitions between the interseptal loculi are accessory tabulae. These may also be seen in *Syringaxon siluriensis* (McCoy) in transverse sections above the aulos (Butler 1935, Pl. 2, fig. 7).

Syringaxon (Saucrophyllum) pocillum sp. nov.

(Pl. XXII, fig. 1-8)

Description: Moderately large, solitary, trochoid corals up to 18 mm in diameter and 25 mm in height. Calyx about 1 cm deep in adult specimens. Epitheca with strong vertical interseptal costae.

Major septa up to 31 in adult specimens with contratingent minor septa often extending over half-way to the aulos, usually present resting against all but the cardinal, counter and counter-lateral septa. Occasionally minor septa not resting against major septa. Major septa, with the exception of the counter-laterals, thicker than minor septa, and somewhat attenuated half-way to the aulos. They are dilated at their extremity to give rise to a well formed aulos up to 5 mm in internal diameter with the axial ends of the septa projecting slightly into the aulos, particularly the cardinal and counter septa. Peripheral stereozone about 0·5 mm thick.

Tabulae within the aulos horizontal, sometimes incomplete, 4 to 7 per 5 mm, usually closer than the outer series between the major septa. A single row of moderately large inclined dissepiments developed within each interseptal loculus between the contratingent septa, extending the full height of the minor septa, well above the calyx.

Type and Figured Specimens: Holotype M. 3021—longitudinal and tangential sections T. 1190-1; Paratype reduced to 7 serially cut transverse sections T. 1192-8; both from Loc. 50, Boola Beds.

Occurrence: Loc. 6 (rare), 11 (rare), 19 (rare), Limestone Phase; Loc. 33 (rare), 35 (rare), Conglomerate Phase, Coopers Creek Formation; Loc. 40 (occasional), 48 (rare), 50 (common), Boola Beds.

Remarks: In transverse section the septa in this species consist of a thin median zone of very dense calcite fibres expanding considerably near the aulos. Investing this median layer is a zone of lamellar stereome which thickens toward the walls and the aulos. In longitudinal section the median zone of the septa may be seen to consist of closely superposed trabeculae which are approximately horizontal or with a slight upward inclination toward the aulos. This fine structure is similar to that of *Syringaxon siluriensis* (McCoy) as described by Wang (1950).

The specimens from Coopers Creek Formation show less thickening of the septa than those from the mudstone of the Boola Beds. Moreover, they are usually smaller and possess fewer septa. They are included, however, in *Syringaxon (Saucrophyllum) pocillum* for the present.

Syringaxon radiatum Hill (1950, p. 144, Pl. 6, fig. 14-15), from the Middle Devonian of Buchan, is possibly a related species although dissepiments are only developed in the proximal parts of the corallum.

Family Mycophyllidae Hill

Genus **Pseudamplexus** Weissermel 1879

Pseudamplexus princeps (Etheridge)

(Pl. XXII, fig. 13)

Tryplasma princeps Etheridge 1907, p. 97, Pl. 15, fig. 1; Pl. 17, fig. 1-5 (*non* 6); Pl. 18, fig. 1, 7; Pl. 19, fig. 1-3; Pl. 20; Pl. 21, fig. 1-9; Pl. 22, fig. 1, 10; Pl. 23, fig. 1-3.
Pseudamplexus affin. *princeps* (Etheridge) Hill 1940a, p. 267.
Pseudamplexus princeps Etheridge, Hill and Jones 1941, p. 185-6, Pl. 3, fig. 1-2.
Pseudamplexus princeps (Etheridge) Hill 1942c, p. 159; Hill 1942e, p. 19.
Pseudamplexus ? princeps (Etheridge) Hill 1950, p. 142.

Description: Large, conical corals up to 35 mm in diameter.

Septa about 70 in number, major and minor septa equally developed, about 2 to 3·5 mm long, dilated at their base so as to be in contact and so giving rise to a peripheral stereozone between 1 and 2·5 mm wide.

Tabulae flat, horizontal, often incomplete, averaging about 1 mm apart. Dissepiments absent.

Figured Specimen: T.1508 from M.3023, Loc. 19, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 19 (rare), Limestone Phase; Loc. 33 (rare), Conglomerate Phase, Coopers Creek Formation. One specimen from Loc. 11, showing differentiation of the major and minor septa and a thicker peripheral stereozone, is questionably placed in this species.

Remarks: In a massive limestone which consists of largely reworked organic debris, it is vitually impossible to establish whether or not this form is sub-compound as is typical of *Pseudamplexus princeps* (Etheridge). In its internal characteristics it agrees with Etheridge's species. The micro-structure of this species has been discussed by Hill (1940a) and Hill and Jones (1941).

Pseudamplexus princeps var. **confertus** var. nov.

(Pl. XXI, fig. 3; Pl. XXII, fig. 11-12)

Diagnosis: *Pseudamplexus princeps* with trochoid coralla and wide peripheral stereozone about 8 mm in diameter.

Description: Corallum large, trochoid, expanding uniformly to a diameter of up to 12 cm over a height of about 16 cm. Calyx about 10 cm deep. Surface apparently marked by longitudinal ridges.

Septa about 85 in number at a diameter of 9 cm, with major and minor septa equally developed, up to 12 mm long and averaging about 10 mm with the last 2 mm free, the rest dilated to form a wide peripheral zone around the corallum. Septa apparently acanthine, occasionally encountered as discrete spines in transverse sections.

Tabulae flat, often incomplete, somewhat thickened, irregularly spaced, averaging about 8 per cm.

Type and Figured Specimen: Holotype M.3024 — T.1513-4, Loc. 19, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 19 (rare), 22 (rare), 23 (rare), 27 (rare), Limestone Phase, Coopers Creek Formation.

Remarks: This form is closely allied to typical *P. princeps* from which it may be distinguished primarily on the basis of the longer septa and the thicker peripheral zone of dilated septa. In this feature it approaches more closely the European Lower Devonian species (e.g. *P. bohemicus* (Barrande), Počta 1902, Pl. 29-33; *P. ligeriensis* (Barrios), Charlesworth 1914, p. 352, Pl. 1a-b, 4-5). The corallum is also apparently more trochoid than is typical of *P. princeps*.

Pseudamplexus sp. (= *Tryplasma princeps* Etheridge of Richards and Bryan 1924) of Hill (1940a) from the Silverwood-Lucky Valley area of Queensland could belong to this new variety, as the dilation and length of the septa are similar. However, the septa are very thick, almost twice that typical of the new variety.

The micro-structure of this form is very similar to *P. princeps*, consisting of large rhabdacanthine trabeculae embedded in lamellar tissue, which may project, however, as short acanthine septa.

Again, it is impossible to tell whether or not this form is sub-compound or solitary. From the material available it cannot be positively stated whether or not this form represents merely a population variant of *P. princeps* or is a separate species of *Pseudamplexus*. Certainly the differences between it and *P. princeps* are most striking.

Family Zaphrentidae Edwards and Haime

Genus **Heliophyllum** Hall 1846

Heliophyllum sp. affin. **H. pinguiseptatum** Hill

(Pl. XXIII, fig. 1, 5)

Affin. *Heliophyllum pinguiseptotum* Hill 1954b, p. 110-1, Pl. 7, fig. 12a-c.

Description: Large, solitary, sub-trochoid coral, with diameter reaching 5 cm.

At a diameter of 4 cm approximately 48 major and minor septa present. Minor septa short, confined to a narrow dissepimentarium usually less than 6 mm wide, while major septa extend three-quarters of the way to the axis of the corallum. Septa of both orders strongly dilated within the dissepimentarium and bearing large, bulbous, yard-arm carinae which in longitudinal section appear as trabeculate flange plates curved upwards and inwards to the axis of the corallum. Dilation of major septa and degree of development of flange plates decreasing within the tabularium where the septa may become attenuated between the flange plates, but are again thickened at their axial ends. An irregular zone a few mm wide occurs around the periphery of the corallum where the septa and flange plates are unthickened. Epitheca thin and peripheral stereozone absent.

Dissepimentarium narrow, usually less than 6 mm wide, but extending up to 10 mm wide within the calcicular region. Dissepiments small, inclined, occasionally slightly thickened, difficult to distinguish in the flange plates, arrayed in about twenty irregular series.

Tabularium wide, consisting of a narrow, outer, upwardly inclined series simulating dissepiments and a wide, flat, close axial series, which may be slightly thickened. Calcicular floor thus domed, axially flat and marginally sloping toward the dissepimentarium; fossula not apparent.

Figured Specimen and Occurrence: M.3025 — T.1517-8, Loc. 20, Limestone Phase, Coopers Creek Formation (rare).

Remarks: This single specimen from the limestone, although similar in size and number of septa to *Heliophyllum pinguiseptatum* Hill from the Lower (?) Devonian of Waratah Bay, differs in a number of features. The most striking of these is in the major septa which in the specimen described by Hill are much more strongly dilated in the tabularium and extend to the axis of the corallum. Moreover, a cardinal fossula is also present. As but a single specimen of *H. pinguiseptatum* is known, the best procedure for the present is to equate the specimen from Tyers with Hill's species, while recognizing the differences which exist between the two. *H. pinguiseptatum* represented the first Australian occurrence of the North American and Moroccan genus *Heliophyllum*.

Family Phillipsastraeidae Roemer

Genus **Phillipsastrea** d'Orbigny 1849

Phillipsastrea maculosa Hill

(Pl. XXII, fig. 14)

Phillipsastraeo speciosa Chapman Hill 1939b (*portim*), Pl. 16, fig. 3-4 (*non* 1-2).
Phillipsostroea maculosa Hill 1942c, p. 153, Pl. 3, fig. 5a-b; 1954b, p. 107, Pl. 6, fig. 1a-b.

Description: Corallum astreoid or thamnasterioid with axes of corallites between 10 and 13 mm apart, and with the tabularia up to 4 mm in diameter but usually about 2·5 mm. Up to 20 septa of each order with the major septa only slightly longer than the minor septa which do not extend into the tabularia. Septa dilated in a zone around the tabularia 1·5 to 2 mm wide, but extending to neighbouring corallites as thin, irregularly carinate plates. Tabulae horizontal; dissepiments arched in zone of dilated septa.

Figured Specimen: T.1519 from M.3026, Loc. 20, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 3 (rare), 20 (rare), Limestone Phase, Coopers Creek Formation.

Remarks: The material, although fragmentary, undoubtedly belongs to this species.

Phillipsastrea speciosa Chapman

(Pl. XXIV, fig. 6)

Phillipsastraea speciosa Chapman 1914, p. 306, Pl. 49, fig. 10-11; Pl. 50, fig. 12-14.
Phillipsastraea speciosa Chapman, Hill 1939b (*partim*), p. 237-8, Pl. 16, fig. 1-2 (*non* 3-4); 1942d, Pl. 6, fig. 8a-b.

Description: Corallum astreoid with axes of corallites 5 mm apart and with tabularia 1·5 to 2 mm in diameter. 28 septa, with major septa more thickened and extending slightly further into the tabularium, dilated in a zone 1·5 to 2 mm wide around the tabularia where they may be slightly carinate.

Figured Specimen and Occurrence: T. 1520, Loc. 15, Limestone Phase, Coopers Creek Formation (rare).

Remarks: This species differs from *P. maculosa* Hill in the smaller and closer tabularia and in possessing fewer septa.

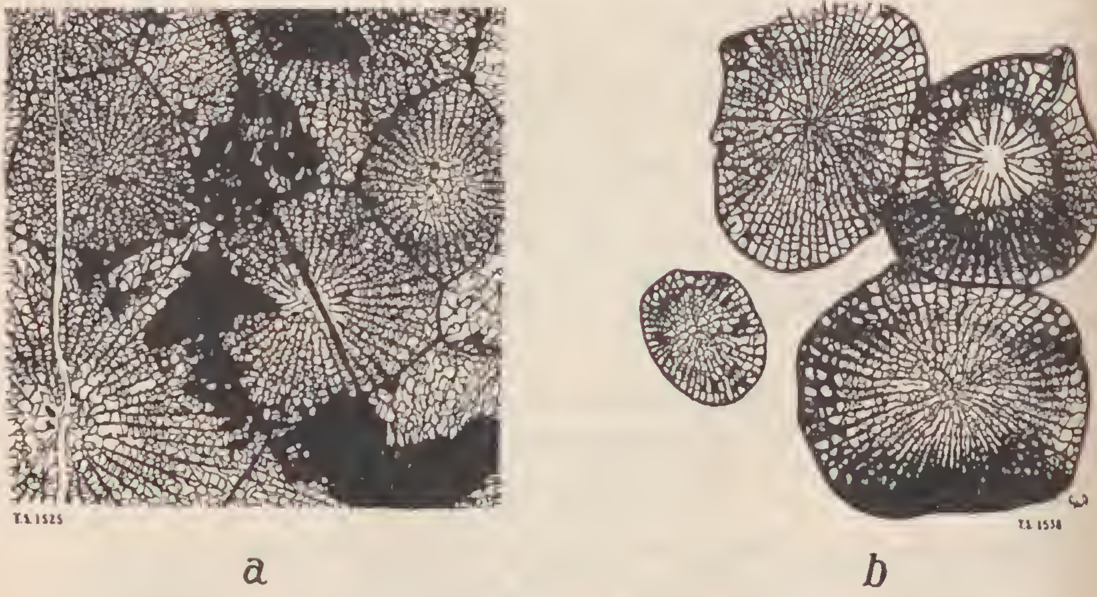

Fig. 4—*Hexagonaria approximans* (Chapman) and *Disphyllum cognatum* sp. nov. (a) T.S. of *Hexagonaria approximans* (Chapman) from portion of T.1525; (b) *Disphyllum cognatum* T.S., T.1538, section from holotype M.3030. x 3.

Genus **Hexagonaria** Gürich 1896

Hexagonaria approximans (Chapman)

(Pl. XXIV, fig. 4, 8-9; Fig. 4a)

Cyathophyllum approximans Chapman, 1914a, p. 304-5, Pl. 47, fig. 5-6.
Prismatophyllum approximans (Chapman) Hill 1939b, p. 234.
Hexagonaria affin. *approximans* (Chapman) Hill 1954b, p. 108, Pl. 6, fig. 4a-b.

Description: Corallum forming large discoidal cerioid masses, with corallites up to 3 cm in diameter, but usually between 10 and 15 mm.

Between 16 and 21 septa of each order present, with major septa usually extending to the axes of the corallites or slightly withdrawn, with the minor septa confined to the dissepimentarium. Major and minor septa slightly dilated within the dissepimentarium with the major septa attenuated in the tabularium; septa carinate, with degree of development varying from specimen to specimen. In general the septa bear yard-arm or more typically zig-zag carinae which are increasingly more strongly developed toward the periphery of the corallites, where, in large corallites, the septa may become attenuated and replaced by naotic dissepiments. Common wall between corallites about 0·1 to 0·2 mm thick.

Dissepimentarium comparatively wide, consisting of up to 11 series of fairly small, thin, globose dissepiments which become progressively more inclined axially. Tabularium narrow, averaging 3·5 mm in diameter, with tabular floors domed to give an irregular axial boss, with flat, well spaced, axial series of tabellae and a periaxial series inclined toward the dissepimentarium.

Figured Specimens: T.1524-5 from M.3027; T.1527 from M.3028; Loc. 11, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 6 (rare), 9 (rare), 11 (occasional), 16 (rare), 20 (rare), 24 (rare), Limestone Phase, Coopers Creek Formation.

Remarks: The material from Tyers establishes this species as being quite variable in the size of the corallites and the degree of development of carinae. Thus *H.* affin. *approximans* of Hill (1954b) should be included within this species. Hill has pointed to the very close comparison which can be drawn between *H. approximans* and the specimen illustrated as *P. sedgwicki* (Edwards and Haime) by Ma (1937).

Genus **Disphyllum** De Fromentel 1861

Disphyllum cognatum sp. nov.

(Pl. XXIV, fig. 5, 10; Fig. 4b)

Diagnosis: Phaceloid corals, up to 20 mm in diameter, usually between 50 to 60 septa of both orders, irregularly carinate in the dissepimentarium with major septa attenuated in the narrow tabularium. Septal trabeculae arranged in fans with zone of divergence a few mm within the corallite walls.

Description: Corallum phaceloid, with corallites cylindrical and sub-parallel, up to 20 mm in diameter.

36 septa of both orders present at a diameter of 7 mm increasing to 62 at a diameter of 20 mm, usually about 50 to 60 septa present, with major septa somewhat spindle-shaped, usually attenuated and slightly wavy within the tabularium where they are withdrawn a little from the axis. Minor septa confined to the dissepimentarium, where, with major septa, they are dilated most strongly toward the inner edge so as to form an irregular stereozone in extremely thickened individuals. Septa of both orders typically bearing close, zig-zag carinae formed of trabeculae

divergent from the axial plane of the septa and most strongly developed where the septa are most thickened. Major and minor septa becoming progressively thinner marginally; peripheral stereozone extremely thin.

Dissepimentarium of a moderately wide outer series of about 4 or 5 vertical columns of fairly large, globose, occasionally thickened dissepiments in 3 or 4 vertical columns. Tabularium about 5 mm across, with tabular floors sub-horizontal, and composed of fairly well spaced flat tabellae.

Septal trabeculae arranged in a fan-like series with zone of divergence 2 to 3 mm from the margins of the corallites so that the outer trabeculae are directed outwards; innermost trabeculae almost horizontal.

TYPE SPECIMEN AND OCCURRENCE: Holotype M.3030, T.1536-9, Loc. 19, 24 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: In internal features, this species resembles *Hexagonaria approximans* (Chapman), particularly in the size of the corallites, the nature of the septa and the dissepiments. *H. approximans*, however, possesses fewer septa and the septal trabeculae are directed inwards from the margins of the corallites. In having the zone of divergence of the septal trabeculae within the corallites *D. cognatum* shows a septal structure more typical of the genus *Phacellophyllum* than of *Disphyllum*.

D. cognatum bears a close resemblance to species of North American disphyllids placed in the genus *Cylindrophyllum*. Of these it is most closely allied to *Cylindrophyllum grabaui* Ehler and Stumm (1949, p. 24-5, Pl. 3, fig. 1-4; Pl. 7, fig. 1-5) from the Middle Devonian of the Traverse Group, Michigan, which has similar dilation and carination of the septa, but differs in other respects such as withdrawn major septa, well spaced, often complete tabulae as well as a more usual *Disphyllum* arrangement of the septal trabeculae. By far the closest comparison which can be drawn is with *Disphyllum* (or *Macgeea*) *trochoides* Hill (1942a, p. 249-50, Pl. 8, fig. 5-10) from the Middle Devonian of Burdekin Downs, Fanning R. and Reid Gap, Queensland, which has fewer septa in early growth stages and lacks the characteristic

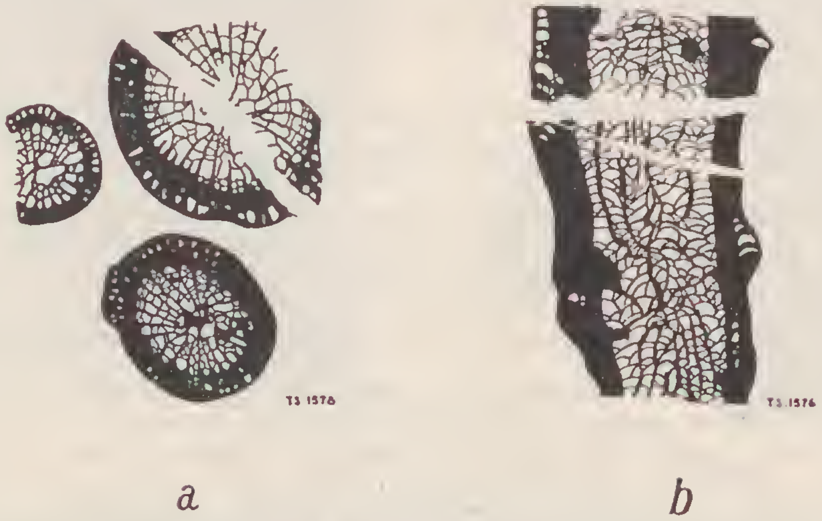

FIG. 5—*Disphyllum incongruum* sp. nov. (a) T.S., T.1578; (b) L.S., T.1576, both from holotype M.3034. x 3.

septal dilation of *D. cognatum* which gives the spindle-shaped septa. Moreover, *D. trochoides* has the septal trabeculae directed inwards from the margins of the corallites.

Disphyllum incongruum sp. nov.

(Pl. XXIV, fig. 1, 7; Fig. 5)

DIAGNOSIS: *Disphyllum* with extremely thickened peripheral stereozone.

DESCRIPTION: Corallum loosely phaceloid, with corallites cylindrical or slowly expanding, up to 12 mm in diameter.

Usually 56 septa present, well differentiated into major and minor; septa of both orders strongly dilated peripherally in the dissepimentarium. Major septa thin and slightly wavy in the tabularium where their axial ends may be united in a loose axial structure, or they may be slightly withdrawn from the axis. Minor septa extending about one-third of the way to the axis, usually confined to the dissepimentarium or extending a short way into the tabularium.

Dissepimentarium strongly thickened, with up to three series of strongly arched dissepiments present, with largest series toward the periphery of the corallites less thickened; steeply inclined dissepiments may be present along the inner margins of the dissepimentarium. Tabularium of short, somewhat arched, regularly spaced, unthickened tabellae, so that tabular floors have a low, axial swelling.

Septal trabeculae closely spaced, at the margins upwardly inclined at an angle of about 45° and becoming more horizontal axially.

TYPE SPECIMEN AND OCCURRENCE: Holotype M.3034 — T.1574-8, Loc. 21, Limestone Phase, Coopers Creek Formation.

REMARKS: The strong thickening within the dissepimentarium distinguishes this species from other species of *Disphyllum* and recalls rather species of *Plexiphyllum* as have been described by Walther (1928) from the Upper Devonian of Germany. The dissepimentarium however does not possess the single series of horse-shoe plates as in *Plexiphyllum*.

Among Australian species *D. incongruum* approaches *Disphyllum* (or *Macgeea*) *excavatum* Hill (1942a, p. 250-1, Pl. 8, fig. 11-13) from the Middle Devonian of Queensland, which is solitary and has more septa as well as a less dilated dissepimentarium.

Disphyllum (?) sp.

(Pl. XXIV, fig. 2-3)

DESCRIPTION: Solitary (?), cylindrical corals up to 15 mm in diameter with 46 major and minor septa present at a diameter of 10 mm. Septa of both orders strongly dilated within the dissepimentarium, tapering from the periphery where they are most strongly thickened, so that the major septa become attenuated in the tabularium; minor septa extending to the edge of the dissepimentarium. Septa of both orders bearing poorly developed zig-zag carinae. Peripheral stereozone narrow, nowhere thicker than 0·3 mm.

Dissepimentarium of an outer zone of about 5 vertical series of small occasionally thickened dissepiments and an inner zone of about 6 vertical series of larger, more inclined dissepiments. Calyx about 8 mm deep with horizontal or slightly domed tabular floors of either closely spaced tabellae or flat complete tabulae extending across the tabularium.

Septal trabeculae upwardly directed at an angle of about 45° marginally, bending over to almost horizontal toward the axis.

FIGURED SPECIMEN AND OCCURRENCE: T.1541-2, Loc. 11, Limestone Phase, Coopers Creek Formation.

REMARKS: This species possesses zig-zag carinae, as does *D. cognatum* sp. nov. The material, however, is not adequate to fully determine the species even at the generic level.

Mictophyllum sp. affin. **M. cresswelli** (Chapman)

(Pl. XXIII, fig. 3-4)

Affin. *Cyathophyllum cresswelli* Chapman 1925, p. 111, Pl. 13, fig. 11-14.
Affin. *Mictophyllum cresswelli* (Chapman) Hill 1939b, p. 246-8, Pl. 14, fig. 7-11.
Affin. *Mictophyllum* cf. *cresswelli* (Chapman) Hill 1942c, p. 159, Pl. 3, fig. 9.
Affin. *Mictophyllum cresswelli* (Chapman) Hill 1954b, p. 109, Pl. 7, fig. 8a-b.

DESCRIPTION: Large, solitary, cylindrical or sub-trochoid corals up to 35 mm in diameter.

At a diameter of 3 cm, 42 major and 42 minor septa present. Major and minor septa dilated within the dissepimentarium with dilation decreasing from the periphery. Minor septa confined to the dissepimentarium, extending a little over one-third of the distance to the axis. Major septa about twice as long as the minor septa, thin in the tabularium and withdrawn from the axis, somewhat curved. Peripheral stereozone wide, apparently continuous, averaging 2·5 mm in diameter.

Dissepimentarium about 6 mm wide, consisting of about 10 series of small, steeply inclined dissepiments. Tabularium wide, with tabular floors domed, and peripheral tabellae inclined toward the dissepimentarium, made up of numerous, fairly small, arched or flat tabellae. Calyx about 15 mm deep.

FIGURED SPECIMEN AND OCCURRENCE: T.1543-4 from M.3031, Loc. 17, Limestone Phase, Coopers Creek Formation.

REMARKS: This single complete specimen of *Mictophyllum* possesses well-developed minor septa similar to other Australian species. It is closest to *Mictophyllum cresswelli* (Chapman) from which it differs in the greater size and the persistent, wide peripheral stereozone, which is absent in adult stages of *M. cresswelli*. It does resemble closely, however, a specimen figured as such by Hill (1939b, Pl. 14, fig. 10-11) which, for its size, possesses more septa than is usual, as well as a comparatively wide peripheral stereozone, which, nevertheless, is variable in thickness. *M. trochoides* Hill (1940b, p. 265, Pl. 11, fig. 7-10) may possess a similar number of septa for comparable dimensions, but in this species the dilation is even less.

Genus **Thamnophyllum** Penecke 1894

Thamnophyllum reclinatum Hill

(Pl. XXIII, fig. 2; Pl. XXV, fig. 1, 2, 7-10)

?*Diphyphyllum Porteri* var. *mitchellensis* Etheridge 1899b, p. 30, Pl. A, fig. 6-8, 12; Pl. B, fig. 11.
Thamnophyllum reclinatum Hill 1939b, p. 228, Pl. 16, fig. 7-8.

DESCRIPTION: Corallum loosely phaceloid with corallites parallel, 3 to 7 mm in diameter, without epitheca, with septa projecting outward as ridges.

24 to 32 septa present, usually poorly differentiated into major and minor septa, although occasional specimens show major septa extending well into the tabularium, inner edge of the dissepimentarium (usually the length of the septa) from one half to three-quarter the radius of the corallites. Septa dilated so that often they may be in contact, particularly toward the peripheral parts of the corallum, sometimes showing a tendency to develop zig-zag carinae.

Dissepimentarium essentially of a single series of small, horse-shoe dissepiments, rarely two series developed; dissepiments varying in size between different corallites, often thickened. Tabularium comparatively narrow, with tabulae rather thickened, well spaced, usually flat or sagging, supplemented at their margins by tabellae.

Septal trabeculae arranged in fans, with zone of divergence coincident with the series of horse-shoe dissepiments; trabeculae outside dissepiments horizontal, about 4 per mm, outer zone up to 2 mm across, but usually between 0·5 and 1 mm.

Only two offsets observed arising from parent corallites with the axils of the branches with irregular dissepimental tissue.

FIGURED SPECIMENS: T.1545 from M.3032, T.1548-9, Loc. 15; T.1546-7, 1550-1, Loc. 20.

OCCURRENCE: Loc. 3 (occasional), 11 (rare), 13 (occasional), 15 (abundant), 19 (rare), 20 (abundant), 21 (occasional), Limestone Phase, Coopers Creek Formation.

REMARKS: The abundant material from Tyers suggests that this species is particularly variable, and so, in all probability, *Thamnophyllum mitchellensis* (Etheridge) from Sandy's Cr. on the Mitchell R., should be regarded as a synonym. Without reference to topotype material from that locality it is premature to place *T. reclinatum* in synonymy with *T. mitchellensis*.

T. reclinatum is one of the more common of the rugose corals of the Limestone Phase of the Coopers Creek Formation at Tyers. It is confined, however, to certain localities.

Genus **Trapezophyllum** Etheridge 1899

Trapezophyllum elegantulum (Dun)

(Pl. XXV, fig. 11-12)

Cyathophyllum elegantulum Dun 1898, p. 85, Pl. 3, fig. 5-6.
Cyathophyllum ? elegantulum Dun, Etheridge 1899b, p. 31, Pl. B, fig. 2-4.
C. (Trapezophyllum) elegantulum Dun, Etheridge 1899b, p. 32.
Trapezophyllum elegantulum (Dun) Hill 1939b, p. 235-6, Pl. 16, fig. 9-11; Stumm 1949b, p. 37, Pl. 17, fig. 21-22.

DESCRIPTION: Corallum cerioid, apparently hemispherical, usually with hexagonal corallites averaging less than 3 mm in diameter. Up to 24 septa in each corallite, with major septa poorly differentiated from minor septa, both orders extending about half-way to the axis of the corallites, thin and somewhat wavy, often slightly thickened at their axial ends.

Dissepiments in two series, with a single, inner series of small, horse-shoe dissepiments developed between the axial ends of the septa, and an outer series of flat or inclined plates, sometimes imbricating. Tabularium about 1·5 mm in diameter with well spaced, flat, slightly thickened tabulae, usually averaging slightly more than 1 mm apart.

FIGURED SPECIMEN AND OCCURRENCE: T.1572-3 from M.3033, Loc. 7, Limestone Phase, Coopers Creek Formation.

REMARKS: Although this single poorly preserved specimen has smaller corallites than is typical for *T. elegantulum*, there is little doubt that it belongs to this species, to date known only from Griffith's Quarry, Loyola. A species of the Australian genus *Trapezophyllum* has recently been described from the Middle Devonian of Germany (Glinski 1955).

Family Craspedophyllidae Dybowski 1873

Genus **Tipheophyllum** Hill 1956

Hill (1956b) proposed the genus *Tipheophyllum* to include the Australian and New Zealand eridophyllids in which the aulos is imperfectly formed although the tabularium is divided into two regions. In species of *Tipheophyllum* zig-zag carinae are more common than in species of *Eridophyllum*. Stewart (1938) has proposed the genus *Schistotoecholasma*, generally regarded as a synonym of *Eridophyllum*, in which the aulos is imperfectly formed, but in species of *Tipheophyllum* no true aulos is present; the axial ends of the major septa may be slightly dilated and bent but are only rarely confluent.

Tipheophyllum ops sp. nov.

(Pl. XXV, fig. 3-4)

Diagnosis: Solitary (?) *Tipheophyllum* with strongly dilated septa and well spaced tabulae.

Description: Solitary (?), cylindrical or slightly expanding corals up to 17 mm in diameter; epitheca apparently smooth, marked by irregular growth annulations.

Up to 52 septa present, well differentiated into major and minor septa, with minor septa extending about half-way to the axis and major septa withdrawn slightly from the axis to give an extremely imperfect aulos about 2 mm wide. Septa of both orders strongly dilated with thickness decreasing from the margins, although thickened to give rise to an irregular stereozone at the inner edge of the dissepimentarium. Septa of both orders within the dissepimentarium bearing strong, irregularly developed, yard-arm carinae, so that at times the septa appear ragged with internal spaces. Minor septa extending a short distance into the tabularium where the septa are more attenuated; major septa slightly dilated at their axial ends, which may be strongly inflected to give rise to the imperfect aulos. Peripheral stereozone 0·2 mm thick.

Dissepimentarium of 4 to 6 series of small, thickened, globose plates, progressively inclined axially so that usually 2 or 3 more series of highly inclined dissepiments are present along the inner margin of the dissepimentarium. Tabularium divided into two series by the imperfect aulos. Outer series of tabellae upwardly arched from the dissepimentarium, inner series flat or sagging, sometimes complete, tabular floors axially depressed so that within the aulos the level is a few mm lower than the level of the corresponding tabellae of the outer series. Tabellae well spaced about 18 in 5 mm.

Septal trabeculae in general upwardly directed at an angle of 45° at the periphery, becoming more horizontal axially. In excessively dilated regions the trabeculae diverge strongly from the midplane of the septa.

Type and Figured Specimen: Holotype M.3035 — T.1579-82, Loc. 15, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 11 (rare), 15 (occasional), Limestone Phase, Coopers Creek Formation.

Remarks: *Tipheophyllum ops* is most closely allied to *Tipheophyllum bartrumi* (Allan), the common E. Australian and New Zealand species. From this species it differs in possessing fewer, more dilated septa and more distant tabulae. The corals collected were all solitary and there was no evidence found suggesting that they were ever compound. This possibility, however, cannot be overlooked.

The trivial name is derived from the Latin '*ops*', meaning 'strength'.

Tipheophyllum sp.

(Pl. XXV, fig. 5-6)

Description: Solitary, rapidly expanding, trochoid coral reaching a diameter of 18 mm at 16 mm from the apex.

44 septa of both orders present at a diameter of 14 mm, major and minor septa well differentiated with minor septa extending half-way to the axis and major septa slightly withdrawn from the axis to give an imperfect aulos. Septa strongly dilated with thickness decreasing axially, carinae small and only rarely present.

Dissepimentarium with a wide series of small, thickened, upwardly arched dissepiments which marginally are inclined toward the periphery, and with an inner zone of inclined dissepiments. Tabularium divided into two regions with an inner sagging series of tabellae within the imperfect aulos.

Septal trabeculae arranged in fans with zone of divergence toward the inner margin of the dissepimentarium.

Figured Specimen and Occurrence: T.1588-9, Loc. 15, Limestone Phase, Coopers Creek Formation.

Remarks: This single, strongly trochoid fragment could be the apical portion of a corallum of *Tipheophyllum ops*, but the nature of the septa and the arrangement of the septal trabeculae suggest that it is a different form.

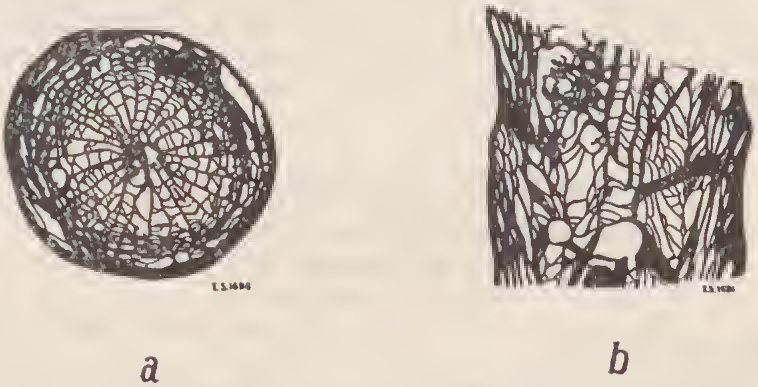

Fig. 6—*Tabulophyllum* (?) *meridionale* sp. nov. (a) T.S., T.1590; (b) L.S., T.1591, both from holotype M.3036. x 3.

Suborder Columnariina

Family Spongophyllidae Dybowski

Genus **Tabulophyllum** Fenton and Fenton 1924

Following Watkins's (1959) restudy of the type species of the general *Tabulophyllum* Fenton and Fenton and *Diversophyllum* Sloss 1939, it is apparent that *Diversophyllum* should be regarded as a synonym of *Tabulophyllum*.

Tabulophyllum (?) meridionale sp. nov.

(Pl. XXVI, fig. 4-5; Fig. 6)

DIAGNOSIS: *Tabulophyllum* with poorly developed minor septa, and major septa amalgamated to give a loose axial structure.

DESCRIPTION: Corallum solitary, cylindrical, attaining a diameter of 15 mm.

50 septa present at a diameter of 14 mm, well differentiated into major and minor septa. Septa of both orders interrupted toward the periphery by lonsdaleoid dissepiments; minor septa rudimentary, usually impersistent, represented in transverse section by trabecular aggregations mounted on the dissepiments, generally confined to the dissepimentarium, but occasionally thin minor septa extend almost to the axis of the corallum. Major septa reaching to the axis of the corallum or withdrawn slightly, axial ends dilated and confluent giving rise to a weak axial structure. Peripheral stereozone narrow, not exceeding 0·5 mm in diameter.

Dissepimentarium up to 4 mm wide with up to 8 series of often thickened, steeply inclined dissepiments. Tabularium of an outer series of strong, upwardly arched tabellae and an inner series of flat tabellae giving rise to a low axial boss a few mm high.

TYPE SPECIMEN AND OCCURRENCE: Holotype M.3036 — T.1590-1, Loc. 15, Limestone Phase, Coopers Creek Formation.

REMARKS: Of the North American Upper Devonian species placed by Fenton and Fenton (1924) in their genus *Tabulophyllum*, *T. meridionale* resembles most closely *T. traversensis* (Winchell), the type species of *Diversophyllum* Sloss 1939. From this species it differs in possessing a wider dissepimentarium and dilation of the axial ends of the major septa to give a loose axial structure.

Solitary spongophyllids are rare in the Devonian of Eastern Australia. *Sinospongophyllum abrogatum* Hill 1942 has been described from the Lower Devonian Mt Etna Limestone, Queensland. This is the first record of the genus *Tabulophyllum* in Eastern Australia, although Hill (1954a) records the genus from the Upper Devonian of Western Australia.

Family PTENOPHYLLIDAE Wedekind

Genus **Acanthophyllum** Dybowski 1873

Acanthophyllum aequiseptatum Hill

(Pl. XXVI, fig. 2-3)

Acanthophyllum aequiseptatum Hill 1941, p. 251, Pl. 9, fig. 1-2; Hill 1942d, Pl. 6, fig. 1a-b; Hill 1950, p. 139, Pl. 5, fig. 1.

DESCRIPTION: Corallum loosely phaceloid, with corallites cylindrical to subtrochoid, up to 15 mm in diameter.

Between 56 and 60 septa of both orders present in adult corallites, with minor septa extending to the inner margin of the wide dissepimentarium (i.e. about three-quarters of the distance to the axis of the corallites) and the major septa extending almost to the axis. Septa of both orders dilated throughout their length, thickening greatest at their base where they are in contact, giving rise to a peripheral stereozone up to 1·5 mm wide. Septa of both orders comparatively straight, in places irregularly carinate, particularly the major septa within the tabularium.

Dissepimentarium wide, consisting of about 10 series of comparatively small, often thickened dissepiments which become progressively inclined axially. Tabularium narrow, with marginally sagging tabellae which give rise to depressed tabular floors.

Figured Specimen and Occurrence: T.1592-3, Loc. 3, Limestone Phase, Coopers Creek Formation.

Remarks: This single, poorly preserved fragment of a phaceloid corallum agrees in all essential features with *A. aequiseptatum* which Hill originally described from the Middle Devonian of Taemas, N.S.W. The corallite diameter is somewhat smaller than in the holotype but is similar to the phaceloid specimen illustrated by Hill (1942d) from Wellington District, N.S.W., again from rocks regarded as Middle Devonian in age.

Acanthophyllum clermontensis (Etheridge)

(Pl. XXVII, fig. 1-2)

Cyathophyllum ? clermontensis Etheridge 1911, p. 5, Pl. B, fig. 1-2; Pl. D, fig. 3.
Aconthophyllum clermontensis (Etheridge) Hill 1939c, p. 57-8, Pl. 4, fig. 1-2; ? Pl. 4, fig. 3-5.
Acanthophyllum ? clermontense (Etheridge) Hill 1941, p. 252-3, Pl. 9, fig. 5.
Acanthophyllum affin. *clermontense* (Etheridge) Hill 1950, p. 139, Pl. 5, fig. 3a-b.

Description: Large, solitary (?). slightly ovate, sub-cylindrical corals up to 6 cm in diameter and at least 15 cm in height.

104 septa present at a diameter of 6 cm, well differentiated into major and minor septa. Septa of both orders slightly carinate, straight and dilated within the dissepimentarium, with the major septa slightly more thickened than the minor septa. A peripheral zone a few mm wide, in which the septa are attenuated, is sporadically developed. Major septa extending unequally to the axis, attenuated at the inner edge of the dissepimentarium, but often thickening again toward their axial ends which are irregularly curved and confluent. Minor septa tapering throughout their length, usually extending two-thirds to three-quarters the radius of the corallum. Peripheral stereozone about 0·5 mm wide.

Dissepimentarium wide, consisting of about 30 vertical series of fairly small, often thickened dissepiments which become progressively inclined toward the inner edge of the dissepimentarium. In transverse section the dissepiments become geniculate toward the periphery where, in the undilated zones, they may become almost naotic. Lateral dissepiments lining the sides of the septa common.

Tabularium one-third to one-quarter the diameter of the corallum, consisting of fairly closely spaced, somewhat upwardly arched tabellae, giving rise to slightly domed tabular floors.

Figured Specimen and Occurrence: M.3037 — T.1599, 1600, Loc. 20, Limestone Phase, Coopers Creek Formation.

Remarks: The most noticeable difference between this single specimen from Tyers and the syntype figured by Hill (1939c. Pl. 4, fig. 1) is in the greater number of septa and their more uniform dilation in the Tyers specimen. The Tyers specimen possesses over 20 more septa than the figured syntype but it is almost twice the size. Etheridge's and Hill's figures show that in *A. clermontensis* the number of septa increases as the coral expands. Thus at a diameter of 15 mm there are approximately 50 septa (Etheridge, Pl. B, fig. 2), at 35 mm there are 70 septa (Etheridge, Pl. B, fig. 1), and at 80 mm (inferred) there are about 80 septa (Hill, Pl. 4, fig. 1). Extrapolation of this suggests that a specimen comparable in diameter to the Tyers specimen would have about 100 septa. On the other hand species such as *Acanthophyllum mansfieldense* (Dun) possess a stable number of septa in expanding from 1 cm to 4 cm.

In the Tyers specimen the major septa tend to meet at the axis rather than twist vortically within the tabularium as in the figured syntype mentioned above. This is of little taxonomic importance as Smith (1945, Pl. 6, fig. 1-2) has illustrated similar variation in *A. heterophyllum* (Edwards and Haime), the type species of *Acanthophyllum*.

It is noteworthy the *A. clermontensis* occurs in a fauna which is best regarded as of basal Lower Devonian age. Hill (1939c), in revising Etheridge's (1911) work on the rugose corals of the Clermont District, Queensland, regarded the small fauna as Upper Couvinian in age. This was based largely on the similarity between *A. clermontensis* and European ptenophyllids.

Acanthophyllum mansfieldense (Dun)

(Pl. XXVI, fig. 11-12)

Cyathophyllum mansfieldense Dun 1898, p. 87, Pl. 3, fig. 3-4.
Acanthophyllum mansfieldense (Dun) Hill 1939b, p. 223-4, Pl. 15, fig. 1-3.
Acanthophyllum sp. cf. *mansfieldense* (Dun) Hill 1940a, Pl. 2, fig. 1a-b.
Acanthophyllum ? mansfieldense (Dun) Hill 1942c, p. 146, Pl. 2, fig. 1.
Acanthophyllum cf. *mansfieldense* (Dun) Hill 1942d, Pl. 5, fig. 1.

DESCRIPTION: Cylindrical to sub-trochoid solitary corals up to 4 cm in diameter; largest corallum fragmentary, at least 8 cm high.

In general 52 septa present from diameter of 1 cm to 4 cm, well differentiated into major and minor septa. Septa of both orders usually strongly dilated in the dissepimentarium with thickening decreasing toward the tabularium, often with wedge-shaped steps which are apparently formed from thickened carinae; occasional specimens show more uniformly tapering septa which may then bear irregular carinae and lateral dissepiments; in such specimens a sporadically developed undilated peripheral zone a few mm wide may also be present. The major septa extend unequally into the tabularium, are withdrawn from the axis in younger specimens, and often slightly dilated toward their axial ends which may be waved. Major septa in the tabularium and the more attenuated axial ends of the minor septa usually irregularly carinate. Minor septa extending to the inner edge of the dissepimentarium, about three-quarters of the distance to the axis of the corallum.

Dissepimentarium wide, consisting of up to 16 vertical series of fairly small, thickened dissepiments peripherally inclined at an angle of about 45° but steepening toward the inner margin of the dissepimentarium; in transverse sections they are frequently geniculate toward the periphery. Tabularium between two-thirds and three-quarters of the diameter of the corallum, consisting of sagging, closely spaced tabellae.

FIGURED SPECIMEN: T.1601-2 from M.3038, Loc. 20, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 3 (occasional), 19 (occasional), 20 (occasional), 21 (rare), 27 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: The material from Tyers suggests that this species is variable in the thickening of the septa, with certain specimens approaching *A. æquiseptatum* in their appearance. One such specimen (T. 1596-7, Loc. 3), doubtfully included in the species, is illustrated (Pl. XXVI, fig. 9-10). The more thickened specimens resemble closely *Acanthophyllum baculoides* (Barrande) (Počta 1902, from the Koněprus; Le Maitre 1934, from the limestones of Chalonnes transitional between the Lower and Middle Devonian) which has, however, more septa.

Acanthophyllum sweeti (Etheridge)

(Pl. XXVI, fig. 7-8)

Cyathophyllum sp. indet. Etheridge 1892b, p. 59, Pl. 3, fig. 11-12.
Cyathophyllum Sweeti Etheridge 1895, p. 521, Pl. 40, fig. 3-4; Pl. 41, fig. 1.
Acanthophyllum sweeti (Etheridge) Hill 1942a, p. 235-6, Pl. 5, fig. 1-5.

DESCRIPTION: Corallum solitary and sub-cylindrical, up to 20 mm in diameter.

52 septa present at a diameter of 17 mm, differentiated into major and minor septa. Septa of both orders somewhat irregular and with irregular carinae present particularly toward their axial ends, regularly dilated and toward the periphery expanding suddenly to give a crenulate peripheral stereozone. Major septa extend unequally toward the axis, somewhat wavy in the tabularium with ends dilated and spatulate; one major septum (counter septum ?) extends right to the axis. Minor septa reach about three-quarters of the distance to the axis.

Calyx with outer surface of the dissepimentarium horizontal, progressively inclined toward the tabularium, strongly thickened in certain zones parallel to the outline of the calyx, apparently representing the position of the calyx in earlier growth stages. Dissepimentarium of about 15 series of small, somewhat arched dissepiments which become steeply inclined toward the inner margins of the dissepimentarium. Tabularium of closely spaced parallel tabellae sagging axially.

FIGURED SPECIMEN AND OCCURRENCE: T.1606-7, Loc. 15, Limestone Phase, Coopers Creek Formation.

REMARKS: This single specimen closely resembles *A. sweeti* (Etheridge) from the Upper Middle Devonian of Burdekin Downs, Fanning R. and Reid Gap, Queensland, but although possessing the same number of septa as this species it is much larger than is typical and the septa are less carinate and are more regular. In the absence of further material it is included in *A. sweeti.*

In the transverse section illustrated an irregular stereozone is present within the dissepimentarium. This is apparently caused by the strong thickening in zones within the dissepimentarium which represent the position of the calyx in early growth stages of the corallum.

Genus **Dohmophyllum** Wedekind 1923

Dohmophyllum pridianum sp. nov.

(Pl. XXVIII, fig. 8-9)

DIAGNOSIS: *Dohmophyllum* with carinate septa, a comparatively narrow dissepimentarium and short minor septa.

DESCRIPTION: Corallum solitary, sub-cylindrical, and somewhat ovate in transverse section, reaching a diameter of 3 cm and a height of at least 7 cm.

58 septa present at a diameter of 3 cm, well differentiated into major and minor septa. Septa of both orders strongly dilated within the narrow dissepimentarium, tapering toward the axis, dilated suddenly toward the periphery to give a peripheral stereozone 1·5 to 2·5 mm wide. Septa of both orders bearing irregular zig-zag carinae, which are large where the septa are thickened, but where the major septa are attenuated in the tabularium the carinae are represented by small irregular projections roughening the sides of the septa. Major septa wavy and broken within the tabularium, extending unequally toward the axis. Minor septa extending to the inner edge of the dissepimentarium, about one-third the way to the axis of the corallum.

Dissepimentarium narrow, with about 5 series of steeply inclined dissepiments which are thickened at definite levels. Tabularium of small, well-spaced tabellae which are upwardly arched to give a broad, axial swelling in the tabular floors. Septal trabeculae almost horizontal, with only a slight upward inclination.

Type Specimen and Occurrence: Holotype M.3039 — T.1613-6, Loc. 13, Limestone Phase, Coopers Creek Formation.

Remarks: This species resembles the species of *Dohmophyllum* with carinate septa included by Wedekind (1923, 24) in his genus *Trematophyllum*. It differs from the German Middle Devonian species chiefly in the comparatively narrow dissepimentarium and concomitantly short minor septa. The axial ends of the major septa in the holotype are broken within the tabularium, a feature which may be seen in other species of *Dohmophyllum*.

Genus **Xystriphyllum** Hill 1939

Xystriphyllum mitchelli (Etheridge)

(Pl. XXVI, fig. 1, 6)

Cyathophyllum mitchelli Etheridge 1892a, p. 172, Pl. 1, fig. 9-10; Pl. 12, fig. 4.
Xystriphyllum mitchelli (Etheridge) Hill 1939c, p. 63; Hill 1941, p. 269, Pl. 11, fig. 2-3; Hill 1942c, p. 147, Pl. 2, fig. 9; Hill 1950, p. 140, Pl. 5, fig. 5-6.

Description: Corallum hemispherical, up to 6 cm in diameter, with corallites cerioid, attaining 7 mm in maximum diameter, usually averaging about 5 mm.

Up to 42 septa present, with major septa extending to the axis of the corallites or irregularly withdrawn and minor septa extending half-way to the axis or less, in places irregularly carinate. Septa of both orders marginally dilated with dilation decreasing toward their free ends, major septa within the tabularium thin and slightly wavy. Septa dilated at their bases to give a peripheral stereozone up to 0·4 mm thick.

Dissepimentarium extending half-way to the axis with up to 5 series of unthickened, inclined dissepiments. Tabularium about 2·5 mm wide with tabular floors horizontal or sagging, with closely spaced tabellae.

Figured Specimen and Occurrence: T.1534-5 from M.3029, Loc. 11, Limestone Phase, Coopers Creek Formation.

Remarks: *Xystriphyllum manipulatum* (Počta 1902, Pl. 103, fig. 3, Pl. 104, fig. 6-7) from the Lower Devonian Koněprus Limestone is a form identical with *X. mitchelli* (Eth.). *Hexagonaria pachytheca* Glinski (1955, p. 90-3, Fig. 11, 12, 14) from the Eifel Middle Devonian probably represents a closely related European species of *Xystriphyllum* with larger corallite diameter. Many of the Devonian species described from Siberia by Bulvanker and Zhmev (*in* Halfina 1955) in the genus *Stenophyllum* appear to be species of *Xystriphyllum*.

Genus **Lyrielasma** Hill 1939

Lyrielasma subcaespitosum (Chapman)

(Pl. XXVIII, fig. 6-7, 11-12)

Cyathophyllum subcaespitosum Chapman 1925, p. 112, Pl. 18, fig. 15a-b, 16.
Lyrielasma subcaespitosum (Chapman) Hill 1939b, p. 244-6, Pl. 14, fig. 1-6; Pl. 15, fig. 6-7; Stumm 1949, p. 34, Pl. 16, fig. 1-2.
Lyrielasma ? subcaespitosum (Chapman) Hill 1954b, p. 111, Pl. 7, fig. 14a-b.
Lyrielasma subcaespitosum (Chapman) Hill 1956a, F. 306, fig. 208, 1a-c.

Lyrielasma subcaespitosum praecursor subsp. nov.

(Pl. XXVIII, fig. 11-12; Fig. 7)

Lyrielasma subcaespitosum (Chapman) Hill 1939b, p. 244-6 (*partim*).
? *Lyrielasma ? subcaespitosum* (Chapman) Hill 1954b, p. 111, Pl. 7, fig. 14a-b.

DIAGNOSIS: *L. subcaespitosum* with large corallite diameter, regular peripheral stereozones and long counter septa.

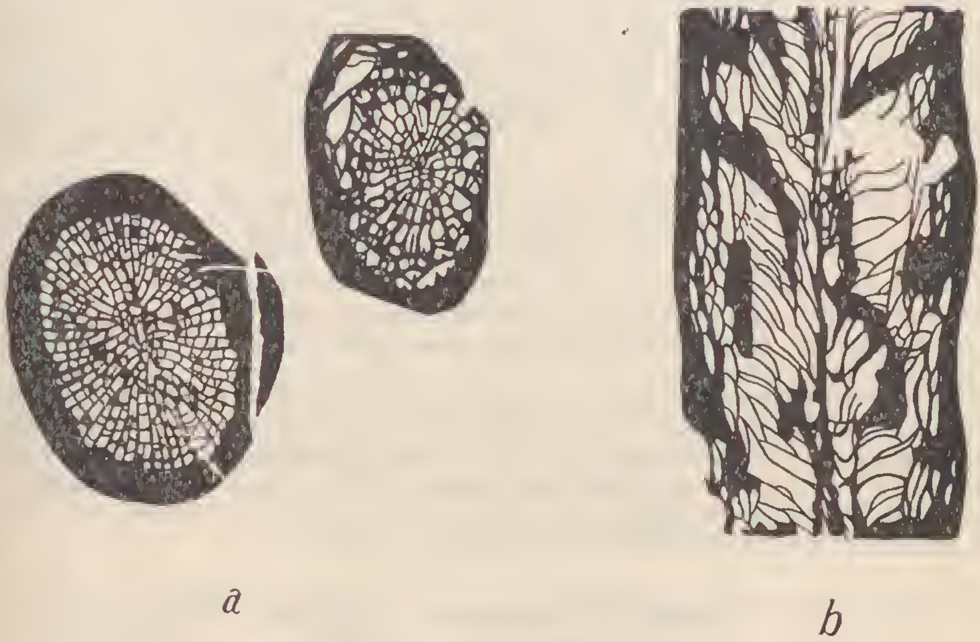

FIG. 7—*Lyrielasma subcaespitosum praecursor* subsp. nov. (a) T.S., (b) L.S. Drawings made from various slides cut from the holotype M.3040. x 3.

DESCRIPTION: Phaceloid corallum with corallites up to 20 mm in diameter, adult corallites averaging about 12 mm.

Up to 62 septa present, differentiated into major and minor septa with major septa usually more dilated than minor septa and extending irregularly to the axes of the corallites, with one septum (the counter ?) usually longer than the rest. Septa of both orders comparatively straight, although major septa within the tabularium often bent toward the plane of the cardinal and counter septa. Minor septa extending about half-way to the axis, often interrupted and broken into discrete trabeculae mounted on dissepiments. Septa of both orders often lonsdaleoid in adult corallites, particularly the thin minor septa. Septa dilated at their base to give a regular peripheral stereozone 1·5 to 4 mm wide in different corallites, usually about 2 mm.

Dissepimentarium comparatively narrow, consisting of 3 to 5 vertical series of inclined dissepiments often thickened at particular levels. Tabularium of widely spaced depressed tabellae giving funnel-shaped tabular floors.

TYPE SPECIMEN: M.3040 — T.1619-25, Loc. 15, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 15 (occasional), 20 (rare), 21 (rare), Limestone Phase. Coopers Creek Formation.

Remarks: The differences between the new subspecies and *Lyrielasma subcaespitosum S.S.* are slight, but as the two can be adequately distinguished it is best to separate the Tyers form in the interests of stratigraphic precision. *L. subcaespitosum praecursor* differs from *L. subcaespitosum S.S.* in its generally larger size, the more regular peripheral stereozone which is slightly narrower, the absence of carinae on the septa and the longer counter septa. The minor septa are in general slightly less well developed and the incidence of lonsdaleoid dissepiments is higher. Another minor difference is that the thickening of the dissepiments in zones within the dissepimentarium is not so marked, nor does it extend to the inner margin of the dissepimentarium. This can be seen well in Pl. XXVIII, fig. 7 where a typical corallite of *L. subcaespitosum S.S.* from the Lilydale Limestone is illustrated for comparison.

The differences listed above are all differences of degree and all the corallites within a corallum do not show them; regardless it is possible to distinguish the subspecies on examination of a number of corallites within a corallum. Thus *L. subcaespitosum S.S.* is known only from the Lilydale Limestone, while the new subspecies includes the form from Loyola discussed by Hill (1939b, p. 245; 1954b, p. 111). The single corallites described from Waratah Bay by Hill (1954c) probably belong to the new subspecies.

An interesting specimen of *L. subcaespitosum S.S.* was found in the material from the Lilydale Limestone sectioned whilst building up a reference collection from that locality. This shows the increase of *L. subcaespitosum* in this case to be peripheral with a circlet of young corallites arising from the widely lonsdaleoid dissepimentarium of the parent corallite, the inner margin of which eventually becomes the epitheca of the parent corallite (Pl. XXVIII, fig. 6).

Suborder Cystiphyllina Nicholson

Family Tryplasmatidae Etheridge

Genus **Tryplasma** Lonsdale 1845

Tryplasma columnare Etheridge

(Pl. XXVIII, fig. 4-5)

Tryplasma columnaris Etheridge 1907, p. 85, Pl. 15, fig. 6; Pl. 19, fig. 5; Pl. 24, fig. 2-5.
Tryplasma columnare Etheridge, Hill and Jones 1940, p. 187-8, Pl. 3, fig. 3-4.

Description: Corallum solitary, cylindrical, attaining 15 mm in diameter, with about 70 short septa poorly differentiated into major and minor, although the major septa are usually longer and extend up to 3 mm into the lumen. Septal trabeculae embedded in lamellar stereome at the base of the septa to give a peripheral stereozone between 1 and 2 mm wide. Septa acanthine along their free edge, breaking into short, upwardly directed spines each consisting of a single rhabdacanthine trabecula.

Tabulae thin, horizontal, usually complete and often bearing short trabeculae, irregularly spaced but averaging about 1 mm apart.

Figured Specimen and Occurrence: T.1639-40, Loc. 5, Limestone Phase, Coopers Creek Formation.

Remarks: The single specimen from Tyers possesses slightly shorter septa than is typical of *T. columnare* but otherwise it agrees closely with the description furnished by Etheridge (1907) and Hill and Jones (1940).

Tryplasma etheridgei sp. nov.

(Pl. XXIX, fig. 2, 4, 6, 8)

DIAGNOSIS: Small *Tryplasma* with long, acanthine major septa, extremely short minor septa and closely spaced, sub-horizontal tabulae.

DESCRIPTION: Solitary (?), cylindrical corallum up to 5 mm in diameter. Epitheca marked by faint septal ridges and growth annulations.

Up to 26 mm long; fairly thick major septa present at a diameter of 5 mm and extending irregularly toward the axis. Septal trabeculae enveloped at the base of the septa by lamellar stereome giving a peripheral stereozone 0·5 to 1 mm wide. Major septa strongly acanthine along their free edge for the last quarter of their length, with spines progressively more upwardly directed axially. Minor septa extremely short, represented by trabeculae embedded in the peripheral stereozone, only very rarely extending into the lumen.

Tabulae thin and flexed, horizontal or slightly domed axially, complete and evenly spaced usually at about 4 per mm, but more in some coralla.

TYPE SPECIMEN AND OCCURRENCE: Holotype—T.1633-4, Loc. 50, Boola Beds; also figured T.1635-6, same locality.

REMARKS: *T. etheridgei* bears little relationship to other described Australian species of *Tryplasma*. Of the overseas species it resembles most closely *Tryplasma malverense* Hill (1936, p. 208-9, fig. 25, 33, 48-49), from the Wenlock Limestone. This species, however, is somewhat larger and has fewer septa and lacks the marked inequality in size between the major and minor septa.

The fine structure of the septa is not well preserved in the material examined but apparently the septal trabeculae are rhabdacanthine.

Tryplasma wellingtonensis Etheridge

(Pl. XXIX, fig. 1, 3)

Tryplasma wellingtonensis Etheridge 1895. p. 160; Etheridge 1907, p. 89, Pl. 16, fig. 5-10; Pl. 21, fig. 11-12; Pl. 22, fig. 2-4; Hill 1942d, p. 187, Pl. 5, fig. 10; Hill 1954b, p. 112, Pl. 8, fig. 16a-b.

DESCRIPTION: Corallum solitary, up to 14 mm in diameter where there are about 60 septa present. Major septa extending about half-way to the axis or slightly less with minor septa about half as long, with septa of both orders usually acanthine axially. Septal trabeculae rhabdacanthine, enveloped in lamellar stereome, marginally giving rise to a peripheral stereozone up to 2·5 mm wide. Tabulae thin, sub-horizontal, somewhat flexed, averaging about 2 mm apart.

FIGURED SPECIMENS: T.1643, Loc. 3; T.1644, Loc. 21, Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 3 (occasional), 20 (rare), 21 (rare), Limestone Phase, Coopers Creek Formation.

REMARKS: *Tryplasma wellingtonensis* closely resembles *T. radicula* Rominger (Stumm 1952, p. 842, Pl. 125, fig. 1-9), from the Middle Silurian of Michigan and Iowa. It also can be compared with *Stortophyllum* affin. *simplex* Wedekind of Soshkina (1937, p. 43, fig. 1-2) from the Upper Silurian of the Urals.

Tryplasma sp. A

(Pl. XXVIII, fig. 3, 10)

DESCRIPTION: Corallum solitary, cylindrical, up to 2 cm in diameter, where 80 septa are present. Septa well differentiated into major and minor septa. Major septa thick, extending unevenly to the axis of the corallum, acanthine along their free edge with large, rhabdacanthine septal trabeculae upwardly directed at an angle of about 20° marginally but increasing to almost vertical axially where discrete spines may be mounted on the tabulae. Minor septa short, up to 3 mm long, equal in length to the width of the peripheral stereozone.

Tabulae often thickened, usually complete, slightly sagging, in certain specimens crowded toward the calyx, usually averaging about 2 mm apart.

Figured Specimens: T.1646, Loc. 15, T.1647, Loc. 22, Limestone Phase, Coopers Creek Formation.

Occurrence: Loc. 3 (occasional), 15 (rare), 20 (rare), 22 (rare), Limestone Phase, Coopers Creek Formation.

Remarks: The extremely long, coarsely trabeculate major septa serve to distinguish this species from other Australian tryplasmids. I have not seen descriptions of any closely comparable overseas species. Although this species is not uncommon in the limestone at Tyers, the material collected was fragmentary and not really suitable on which to base a new species.

Tryplasma sp. B

(Pl. XXIX, fig. 5, 7)

Description: Corallum up to 20 mm in diameter and up to 10 cm high. Epitheca marked by longitudinal septal ridges and irregular growth annulations.

About 70 short septa present at a diameter of 15 mm, with major septa slightly longer than minor septa, projecting as short spines from the peripheral stereozone up to 3 mm wide. Tabulae well spaced, usually horizontal and complete and often thickened by lamellar stereome, usually averaging about 2 mm apart, but often with a tabula resting for much of its width on a lower tabula.

Figured Specimen and Occurrence: T.1648-9, Loc. 48, Boola Beds.

Remarks: This form is apparently different from the other Australian species of *Tryplasma* of comparable dimensions. It could be close to the imperfectly known *T. murrayi* Etheridge (1907, p. 93) from Waratah Bay.

Certain coralla from Loc. 48, associated with *Tryplasma* sp. B, although possessing similar external characteristics, possess a thinner stereozone and regular, unthickened tabulae. These could represent a further species of *Tryplasma* but further material is necessary before they can be separated with confidence from *Tryplasma* sp. B.

The septal trabeculae of this species are well-spaced rhabdacanths which in places have recrystallized to give holacanths.

Family Cystiphyllidae Edwards and Haime

Genus **Microplasma** Dybowski 1873

Microplasma sp. cf. **M. devonica** Soshkina

(Pl. XXVII, fig. 13, Pl. XXIX, fig. 2, 6)

Cf. *Microplasma devonica* Soshkina 1937, p. 79-80, Pl. 15, fig. 5-6.

Description: Solitary (?), cylindrical corals up to 8 mm in diameter with epitheca marked by irregular growth annulations. Peripheral stereozone up to 1 mm wide, apparently made up of trabeculae representing the septa. Horizontal skeletal elements large, in certain specimens differentiated into a peripheral series of inclined dissepiments and an axial series of upwardly arched tabulae; in other specimens not clearly differentiated with lumen filled by two or three series of unthickened globose plates.

FIGURED SPECIMEN AND OCCURRENCE: T.1635-6; T.1670, Loc. 50, Boola Beds.

REMARKS: In the specimens of this form available for study, the preservation is such that it is very difficult to establish positively the trabecular nature of the peripheral stereozone. Although most of the specimens are apparently solitary the juxtaposition of coralla in one section suggests a phaceloid growth habit.

The holotype of *M. devonica* Soshkina, from the slopes of the Urals, falls within the range of variation of the material from Tyers, but the rather poor preservation of the Tyers specimens prevents positive identification with Soshkina's species. *M. devonica* was described from rocks regarded by Soshkina as being of Coblenzian age.

Among Australian species *M. devonica* resembles most closely *'Cystiphyllum' conjunctum* Hill (1942d, p. 185, Pl. 5, fig. 3a-b) from the Wellington district, N.S.W., but this species in its gross morphology is more closely allied to *M. nesterowskii* Peetz.

Genus **Cystiphyllum** Lonsdale 1839

'Cystiphyllum' sp. affin. **'C.' australe** Etheridge

(Pl. XXVIII, fig. 1-2)

Affin. *Cystiphyllum americanum* Edwards and Haime, var. *australe* Etheridge 1892, p. 58, Pl. 3, fig. 13-14.

Affin. *'Cystiphyllum' australe* Etheridge, Hill 1942a, p. 243-4, Pl. 6, fig. 10-13.

DESCRIPTION: Corallum solitary, up to 25 mm in diameter with peripheral stereozone up to 3 mm wide in which are present short, closely spaced trabeculae, which may extend on to the outer dissepiments. Tabularium about half the width of the corallum, poorly differentiated from the dissepimentarium. The plates of the dissepimentarium are smaller, more inclined and less arched than those of the tabularium. Slight dilation of the dissepiments is present in certain zones within the corallum.

FIGURED SPECIMEN AND OCCURRENCE: T.1672-3, Loc. 13, Limestone Phase, Coopers Creek Formation.

REMARKS: This form agrees closely with *'C.' australe* Etheridge from the Middle Devonian of Queensland, except that the peripheral stereozone is much wider and there are present very poorly developed zones of skeletal dilation. *'Cystiphyllum'* sp. of Hill (1939b), from Loyola, could represent a similar form.

Hill (1942a) has suggested possible relationships of *'Cystiphyllum' australe* to overseas species.

Other fragmentary cystimorphs were encountered in thin section from various localities. These are recorded in Table 1 as *'Cystiphyllum'* spp.

Family GONIOPHYLLIDAE Dybowski

Genus **Rhizophyllum** Lindström 1866

Rhizophyllum (?) sp.

(Pl. XXI, fig. 7)

One fairly large internal mould of a calceoloid corallum (M. 3042) was collected from Loc. 48, Boola Beds. This measured 10 mm high with an aperture of 17 x 10 mm. Without more material positive identification of this specimen is impossible.

PHYLUM BRACHIOPODA

Class ARTICULATA

With constant elevation of the taxonomic categories of articulate brachiopods, in present classifications (e.g. Muir-Wood 1955) the anomalous situation is found of the separation of punctate and impunctate members of a particular group at the suborder level e.g. Orthoidea and Dalmanelloidea, and it is at this level that the other main brachiopod groups are separated e.g. Spiriferoidea. Clearly this scheme does not reflect the true relations within the Articulata, even admitting the doubtful supposition that punctation has arisen but once in each stock. In the descriptions below the classification is carried only to the superfamily level.

Superfamily ORTHACEA Walcott and Schuchert

Family ORTHIDAE Woodward

Genus **Dolerorthis** Schuchert & Cooper 1931

Dolerorthis persculpta sp. nov.

(Pl. XXX, fig. 1-6; Fig. 8)

DIAGNOSIS: *Dolerorthis* with strong radial ornament, comparatively high dorsal interarea, and small ventral muscle area.

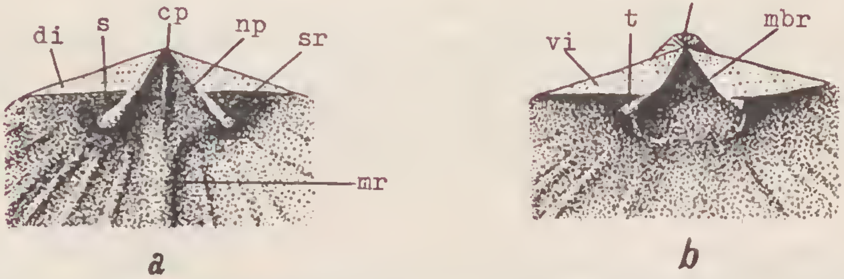

FIG. 8—*Dolerorthis persculpta* sp. nov. (a) Dorsal interior drawn from latex impression of holotype M.3416; (b) Ventral interior based on latex impressions of M.3417-20. di: dorsal interarea, cp: cardinal process, np: notothyrial platform, s: socket, sr: socket ridge, mr: median ridge, mbr: muscle bounding ridge, t: teeth, u: umbo, vi: ventral interarea. x 5 approx.

DESCRIPTION:

EXTERIOR—Outline subquadrate, with greatest width half-way between mid-length of shell and the long hingeline; shell unequally biconvex with ventral valve more strongly arched. Dorsal valve with a sharp, strong sulcus which flattens anteriorly so that the anterior commissure is broadly sulcate. Ventral interarea plane or slightly concave, higher than dorsal interarea, and apsacline. Dorsal interarea plane with a faint furrow running from the umbo just outside the notothyrium; from strongly anacline to orthocline. Ventral umbo more strongly incurved than the dorsal umbo. Delthyrium and notothyrium open.

Surface ornament of strong, fascicostellate ribs, which are crossed by fine, closely spaced growth ridges. Each valve bearing about 35 costae which marginally are spaced at about 2 per mm.

VENTRAL INTERIOR—Delthyrial cavity comparatively deep, bounded laterally by the weak dental lamellae or their anterior continuation on the floor of the valve as weak muscle bounding ridges. Teeth moderately strong, triangular, and placed laterally from the delthyrial margin, supported by weak, receding dental lamellae. Muscle area small, triangular and extending only a short distance anterior from the teeth, not clearly differentiated into adductors and diductors, but presumably with the narrow adductors extending to the front of the muscle area.

DORSAL INTERIOR—Notothyrial cavity shallow, with a high notothyrial platform which is continued anteriorly as a median ridge. Cardinal process long and linear, mounted on the notothyrial platform, and lacking subsidiary ridges. Inner socket ridges short, somewhat bladed, and outlining comparatively shallow sockets. Dorsal musculature not apparent.

[The term 'socket ridges' or 'inner socket ridges' is to be preferred to the term 'brachiophores' of Schuchert and Cooper (1932) in describing the outgrowths of cardinalia anteriorly bounding the sockets in orthacids, dalmanellacids, and certain strophomenacids, as this latter term implies false homologies with the crural bases of such groups as the rhynchonellacids. In orthacids and dalmanellacids it is extremely doubtful whether these structures could have served as lophophore supports (*fide* Williams 1956, p. 263 *et seq.*)]

MEASUREMENTS: M.3416, l. = 13 mm, w. = 15 mm.

TYPE AND FIGURED SPECIMENS: Holotype M. 3416 (dorsal valve); M.3417—both from Loc. 47, Boola Beds; M.3415, Loc. 48, Boola Beds.

OCCURRENCE: Loc. 47 (occasional), 49 (occasional), Boola Beds.

REMARKS: The surface ornament, the receding dental lamellae and the teeth placed laterally from the delthyrial margins, as well as details of the cardinalia ally this species with those included in the North American and European Silurian genus *Dolerorthis*. Externally it perhaps resembles most closely *'Schizoramma' nisis* (Hall and Whitfeld) (Schuchert and Cooper 1932, Pl. 5, fig. 11, 16) but *D. persculpta* is a larger and proportionately wider form.

Superfamily DALMANELLACEA

Family ONNIELLIDAE Öpik

Genus **Onniella** Bancroft 1928

(= ? *Dalmanella* Hall and Clarke 1892 *sensu* Schuchert and Cooper 1932)

Onniella (?) tyersensis sp. nov.

(Pl. XXX, fig. 7-11; Fig. 9)

DIAGNOSIS: Small, biconvex *Onniella* with wide median separation of the dorsal muscle field, and possessing a long-shafted cardinal process with a large, bilobed myophore.

DESCRIPTION:

EXTERIOR—Outline subcircular, with greatest width about midlength of the shell; both valves evenly convex, but with a higher interarea on the ventral valve. A faint sulcus may be present in the posterior of the dorsal valve, but it fades anteriorly so that the anterior commissure is usually rounded. Interareas plane, with ventral interarea apsacline, dorsal interarea anacline; delthyrium and notothyrium open.

Surface ornament fascicostellate, with each valve bearing about 40 costellae, marginally spaced at about 4 or 5 per mm. Costellae crossed by irregularly spaced, concentric growth lines.

Ventral Interior—Delthyrial cavity comparatively deep, bounded by short, vertical, receding dental lamellae. Teeth moderately strong, triangular, with poorly defined 'socket ridge fossettes'. Dental lamellae continued anteriorly as a poorly defined muscle bounding ridge. Ventral muscle area not incised, triangular and extending only a short distance anteriorly from the base of the dental lamellae.

Dorsal Interior—Inner socket ridges comparatively heavy, somewhat cylindrical, anteriorly outlining deep sockets which posteriorly are defined by short swellings below the dorsal interarea, extending the length of the socket and widening laterally. Cardinal process in general with a bilobed myophore filling the notothyrial cavity, and supported by a long shaft which usually extends well down the low wide median ridge which separates the adductors. The muscle impressions are poorly defined but suggest widely separated elliptical adductors in which the separation into anterior and posterior pairs is not visible.

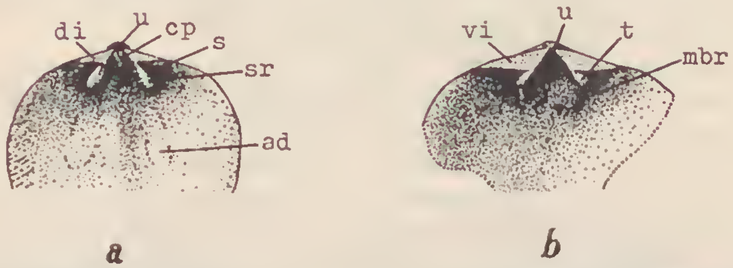

Fig. 9—*Onniella* (?) *tyersensis* sp. nov. (a) Dorsal interior drawn from latex impression of holotype M.3424; (b) Ventral interior drawn from latex impression of M.3425. cp: cardinal process, di: dorsal interarea, ad: adductor impressions, s: socket, sr: socket ridge, u: umbo, t: tooth, vi: ventral interarea, mbr: muscle bounding ridge. x 5 approx.

Measurements: M.3424, l. = 7 mm, w. = 7 mm.

Type and Figured Specimens: Holotype M.3424 (dorsal valve), M.3421-3, all from Loc. 43, Boola Beds.

Occurrence: Loc. 40 (rare), 43 (common), 47 (rare), Boola Beds.

Remarks: There exists a certain amount of confusion in the generic naming of dalmanellacids, initiated by Schuchert and Cooper (1932) in their interpretation of *Dalmanella* Hall and Clarke, for they took as type of the genus *Dalmanella testudinaria* of Hall and Clarke, not Dalman. Öpik (1933) pointed to the error of this procedure, and claimed that the large number of species referred to *Dalmanella* by Schuchert and Cooper should be placed in *Onniella* Bancroft, regarded by Schuchert and Cooper as a probable synonym of *Dalmanella*. Cooper (1942, p. 229) did not altogether agree with this and stated that most of the species are congeneric with *Resserella* Bancroft, but subsequently (1944) regarded *Onniella* as a subgenus of *Resserella*. More recently Cooper (1956, p. 956) noted that the specimen chosen by Schuchert and Cooper as lectotype of *Orthis canalis* Sowerby 1839, type species of *Resserella* Bancroft, is congeneric with *Parmorthis* Schuchert and Cooper, and so proposed the new genus *Paucicrura* to embrace those species he had formerly placed in *Resserella*. Thus *Onniella* Bancroft and *Paucicrura* Cooper should replace *Dalmanella* Hall and Clarke of Schuchert and Cooper and *Resserella* Bancroft of Cooper; *Resserella* Bancroft replaces *Parmorthis* Schuchert and Cooper; *Dalmanella* Hall and Clarke replaces *Wattsella* Bancroft. It seems likely that *Paucicrura* Cooper is a synonym of *Onniella* Bancroft.

The genus *Onniella* Bancroft has been interpreted rather broadly to include *O.* (?) *tyersensis*. Externally and in the internal features of the ventral valve it is closely comparable to such species as the Upper Silurian *'Dalmanella' crassiformis* Kozlowski 1929 (p. 67, Pl. 1, fig. 30-1), but from this and similar species it differs in the long-shafted cardinal process, the comparatively heavy socket ridges and the wide separation of the dorsal muscle fields. *Onniella distincta* Poulsen (1934, p. 14, Pl. 1, fig. 12-15), from the Silurian of Greenland, is a species which also possesses this last feature. Forms closely related to *O.* (?) *tyersensis* are known to occur in the Melbourne Beds.

Genus **Tyersella** gen. nov.

Diagnosis: Large, biconvex, multicostellate onniellids with low interareas, thick pedicle callist, heavy triangular teeth supported by strong advancing dental lamellae continued anteriorly as a muscle bounding ridge of the elongate schizophorid ventral muscle field. Dorsal interior with strong diverging inner socket ridges, small bilobed cardinal process and with large anterior adductors separated from the small posterior adductors by a transverse ridge. Ventral pallial sinuses digitate, closely comparable to those of *Levenea*.

Type Species: *Tyersella typica* sp. nov.

Relations: The features of the dorsal valve of *Tyersella* are extremely close to those of the North American and European Silurian and Devonian genus *Levenea*. The only noticeable difference is the marked inequality in the size of the anterior and posterior adductors in *Tyersella*. The close relationship can be seen particularly in the pattern of the dorsal pallial sinuses, for those of *Tyersella* are exactly identical with those of *Levenea* as shown by Schuchert and Cooper (1932, p. 40, Fig. 14). The two genera are obviously distinct in the ventral musculature which in *Tyersella* is elongate with a strong median ridge and is typically schizophorid in character, whereas that of *Levenea* is short and pentagonal in outline. *Levenea* also has obsolete dental lamellae in adult growth stages, whereas in *Tyersella* they are strongly developed in all growth stages. Because of emphasis placed by Schuchert and Cooper on the presence or absence of fulcral plates in the classification of dalmanellacids, *Tyersella* must be placed with other such genera which lack fulcral plates in the Onniellidae. However Bancroft (1945, p. 187) has questioned the use of this feature for classification at the family level. Bancroft writes 'The presence of fulcral plates in immature individuals of certain Dalmanellidae detracts greatly from the merits of this classification, and it is further impaired by the fact that those structures persist in certain individuals of species which have normally the *Dalmanella* type of crural plate. Even on an artificial basis the classification is, therefore, unsatisfactory.' Should fulcral plates be disallowed as a feature of prime classificatory value, then *Tyersella* would find its place in the Schizophoriidae, along with such genera as *Schizophoria, Isorthis* and perhaps *Levenea* on the basis of surface ornament, musculature, general features of the cardinalia and more especially the similarity in the dorsal pallial sinuses, particularly with those of the last two genera.

Tyersella typica sp. nov.

(Pl. XXX, fig. 12-19; Fig. 10)

DESCRIPTION:

EXTERIOR—Large, subequally biconvex onniellids with short hinge line, rounded outline and anterior commissure, and with greatest width about midlength of the shell. Ventral interarea comparatively low and convex with umbo slightly incurved, apsacline and with delthyrium narrow and open; dorsal interarea extremely low and plane, anacline or orthocline, and with open notothyrium the margins of which curve outwards from the umbo so that it is not clearly delineated within the interarea.

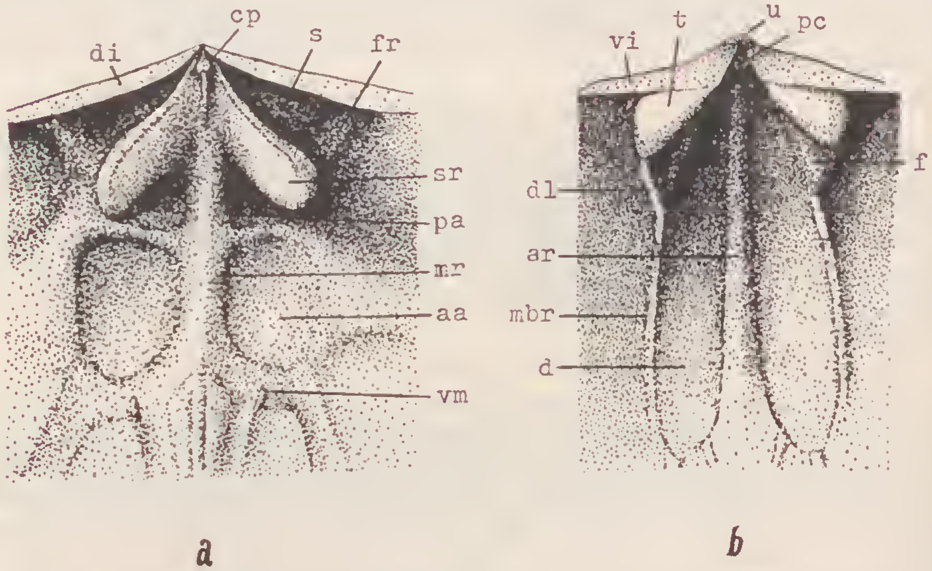

FIG. 10—*Tyersella typica* gen. et sp. nov. (a) Dorsal interior based on latex impression of holotype M.3426; (b) Ventral interior based on latex impression of M.3428. cp: cardinal process, di: dorsal interarea, s: socket, sr: socket ridge, fr: fulcral ridge, aa: anterior adductor impression, pa: posterior adductor impression, mr: median ridge, vm: vascula media, ar: adductor ridge, d: diductor scar, dl: dental lamella, f: 'socket ridge' fossette, mbr: muscle bounding ridge, pc: pedicle callist, t: tooth, u: umbo, vi: ventral interarea. x 5 approx.

Surface ornament parvicostellate with each valve bearing about 140 fine costellae spaced 4 per mm around the anterior commissure.

VENTRAL INTERIOR—Delthyrial cavity deep and narrow, laterally outlined by the strong advancing dental lamellae which are continued anteriorly as a high muscle bounding ridge. Posteriorly the delthyrial cavity is shallowed by a large triangular pedicle callist (= pedicle collar?) at the apex of the valve showing transverse muscle markings. Teeth strong and triangular with deep 'socket ridge' fossettes immediately beneath the teeth at the anterior end of the dental plates. Ventral muscle area elongate, posteriorly bounded by the pedicle callist and extending anteriorly from between one-half and one-third of the distance to the anterior margin, and consisting of two narrow slightly expanding diductor furrows separated by a high narrow adductor ridge which shallows posteriorly. Ventral pallial sinus obscure, but apparently digitate.

Dorsal Interior—Diverging inner socket ridges extremely high and heavy, occasionally bearing a slight longitudinal furrow along their upper edges (dorsal adjustor scars?), and anteriorly bounding large sockets. Cardinal process small, with a short shaft and a usually bilobed myophore and often with a posterior continuation of the shaft past the myophore to the umbo. Dorsal muscle bounding ridges arising from the base of the socket ridges, outlining the adductor field which extends about half-way to the anterior margin. Adductors medianly divided by a low ridge, caused mainly by the incision of the muscle areas into the floor of the valve. Posterior adductors small, triangular, almost hidden by the overhanging socket ridges, and separated from the larger, more rounded anterior adductors by a transverse ridge arising just anterior to the base of the socket ridges and extending slightly backwards across the muscle area to meet the median ridge. Dorsal pallial sinuses digitate with the vascula media arising from just anterior of the muscle field and immediately bifurcating into a median trunk which is continued to the anterior margin with a slight tendency to bifurcate again near the margin, and a lateral trunk which extends from the anteriolateral margin of the adductor at about 45° to the midlength of the shell and bifurcates half-way to the margin. The vascula myaria arise from the junction of the anterior and posterior adductors and extend laterally to bifurcate half-way to the margin of the shell.

Gerontic Features: The abundant material from Tyers illustrates a number of changes which take place during the ontogeny of this species. Apart from such usual features as the deposition of secondary material thickening the socket ridges and dental lamellae, and the general incision of muscle areas and pallial sinus, one finds that the sockets become secondarily outlined by low fulcral ridges (Pl. XXX, fig. 14), there is also the development of a weakly papillose genital area on each side of the ventral muscle area (Pl. XXX, fig. 18), there may be secondary deposition of shell material along the paths of the vascula myaria valve in the dorsal so that they appear as ridges (Pl. XXX, fig. 13), and a median ridge in the dorsal valve anterior to the muscle field and separating the vascula media may be developed (Pl. XXX, fig. 13-14).

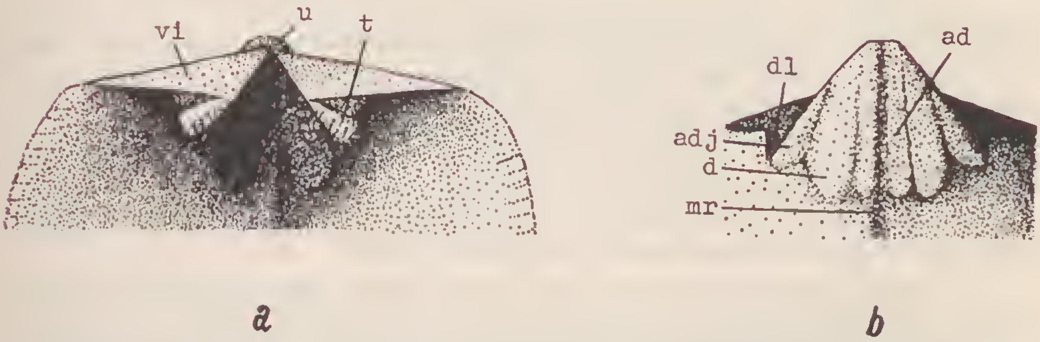

Fig. 11—*Resserella impensa* sp. nov. (a) Ventral interior drawn from latex impression of M.3431; (b) Internal mould of ventral valve M.3431. ad: adductor impression, adj.: adjustor impression, d; diductor impression, dl: dental lamella, mr: median ridge, t: tooth, u: umbo, vi: ventral interarea. x 5 approx.

MEASUREMENTS: M.3426, l. = 21 mm, w. = 20 mm.

TYPE AND FIGURED SPECIMENS: Holotype M.3426 A, B (dorsal valve); M.3425, 7-9, all from Loc. 36, Conglomerate Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 2 (rare), 11 (occasional), 18 (rare), Limestone Phase; Loc. 29 (rare), 30 (occasional), 31 (rare), 34 (rare), 35 (?), 36 (abundant), Conglomerate Phase; 47 (rare), 49 (rare), Boola Beds.

REMARKS: The material from the limestone is extremely fragmentary, so that the identifications are based on external features alone. A further undescribed species of *Tyersella* has been collected from the Kinglake district.

Family DALMANELLIDAE Öpik

Genus **Resserella** Bancroft 1928

(= *Parmorthis* Schuchert and Cooper 1931)

Resserella impensa sp. nov.

(Pl. XXX, fig. 20-4; Fig. 11)

DIAGNOSIS: Large *Resserella* with comparatively coarse fascicostellate ornament, widely separated socket ridges and upright cardinal process.

DESCRIPTION:

EXTERIOR—Outline rounded with greatest width just anterior to the comparatively long hinge line; cardinal extremities rounded. Shell plano-convex with ventral valve strongly convex and arched. A faint sulcus may be present in the dorsal valve, but this fades anteriorly so that the anterior commissure is rounded. Ventral interarea high and strongly convex with the ventral umbo strongly incurved over the hinge line. Ventral interarea apsacline and dorsal interarea anacline. Both delthyrium and notothyrium wide and open, although notothyrium tends to be closed by the cardinal process.

Surface of both valves fascicostellate with each valve bearing about 80 costellae which marginally are spaced at about 3 or 4 per mm. A zone of fine costellae is sometimes present medianly in immature specimens.

VENTRAL INTERIOR—Delthyrial cavity deep and bounded laterally by heavy dental lamellae the base of which is projected anteriorly as low muscle bounding ridges. A small triangular pedicle callist is present at the apex of the ventral valve. The teeth are strong and triangular with heavy crenulations along their inner surfaces. Ventral muscle area confined to the delthyrial cavity, triangular in shape and consisting of flabellate diductor scars situated each side of lanceolate adductor impressions which are separated by a low median ridge. Adjustors represented as large triangular scars lateral and somewhat posterior to the diductors and extending up the sides of the dental lamellae. Deep 'socket ridge fossettes' are developed beneath the teeth at the anterior end of the dental plates.

DORSAL INTERIOR—Sockets deep and crenulate, laterally bounded by low fulcral plates and anteriorly delimited by the heavy, widely separated, divergent, inner socket ridges. Cardinal process with short shaft only extending a short distance down the median ridge, directed more ventrally, giving rise to an upright cardinal process bearing a bilobed myophore which tends to close the notothyrium. Dorsal muscle area elongate and narrowing anteriorly, extending about half-way to the anterior margin. Adductors separated by a narrow median ridge which stops abruptly at the anterior end of the muscle area. Anterior adductors much smaller than posterior adductors and separated by an ill-defined ridge which extends slightly backwards across the muscle area.

MEASUREMENTS: M.3430, l. = 11 mm, w. = 12 mm.

TYPE AND FIGURED SPECIMENS: Holotype M.3430, Loc. 48, Boola Beds; M.3431-2, Loc. 36, Conglomerate Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 40 (rare), 48 (occasional), Boola Beds; Loc. 34 (rare), 36 (common), Conglomerate Phase, Coopers Creek Formation.

REMARKS: The ventral musculature, the strongly crenulate teeth, the upright cardinal process and the elongate dorsal muscle area with the small anterior adductors show this form to be a species of the Silurian genus *Resserella*. The coarse ornament, tending to be fascicostellate, separates the species from the North American and European representatives of the genus. The ornament, however, is not so coarse as that of *Resserella crassicostata* (Schuchert and Cooper 1932, Pl. 21, fig. 4-5). The upright cardinal process is a feature seen in other species of *Resserella* and is most strongly developed in *R. visbyensis* (Lindström). It is a character probably related to the leverage required to open the valves in forms with flat dorsal valves and strongly arched ventral valves.

The genus *Resserella* has previously been described from Australia twice (as *Parmorthis*) but both these identifications may be questioned. *Parmorthis vandiemeni* Gill (1948, p. 65, Pl. 8, fig. 30) from the Lyell Highway, Tasmania, does not appear to possess the dorsal musculature of *Resserella*. No description of the ventral valve is given and the description and figure of the dorsal valve are such that even the correct family relationships of the species are obscure. The general pattern of the dorsal interior however appears to be unlike that of any of the Tyers dalmanellacids. Gill (1950) recorded the genus again from Tasmania, but again the generic identification of the specimen concerned is far from clear (see p. 203). Much of the literature on the Silurian and Devonian stratigraphy and palaeontology of Victoria contains references to the occurrence of '*Orthis elegantula* Dalman' or '*Dalmanella elegantula* (Dalman)' but this identification appears to have been applied indiscriminately to any dalmanellacid.

Family SCHIZOPHORIIDAE Schuchert

Genus **Isorthis** Kozlowski 1929

Isorthis festiva sp. nov.

(Pl. XXXI, fig. 3-6; Fig. 12)

DIAGNOSIS: *Isorthis* with comparatively strong dental lamellae, bladed inner socket ridges and large dorsal muscle area.

DESCRIPTION:

EXTERIOR—Outline rounded, with greatest width slightly posterior to the midlength of the shell. Hinge line short, with rounded cardinal extremities. Shell unequally biconvex, with ventral valve more strongly arched than dorsal valve. A low sulcus, extending to the broadly sulcate anterior commissure, is present in the dorsal valve. Ventral interarea plane, higher than dorsal interarea, apsacline. Dorsal interarea plane and anacline. Delthyrium and notothyrium both open.

Surface of both valves multicostellate, with each bearing about 110 costellae which marginally are spaced at about 4 per mm.

VENTRAL INTERIOR—Delthyrial cavity fairly deep and bounded laterally by comparatively strong dental lamellae which support triangular teeth. The dental lamellae are continued anteriorly for a short distance as low muscle bounding ridges. Ventral muscle area elongate, extending about one-third the distance to the anterior commissure, and consisting essentially of two narrow, expanding diductor scars set on each side of a narrow adductor ridge. Obscure adjustor scars present laterally to the diductor impressions at the base of the dental lamellae.

DORSAL INTERIOR—Sockets deep, laterally bounded by low fulcral plates and anteriorly delineated by the comparatively thin and bladed inner socket ridges. Cardinal process with fairly long shaft and usually bilobed myophore tending to close the notothyrium. Dorsal muscle area subquadrate, usually extending more than half-way to the anterior margin, with a wide median ridge. Posterior and anterior adductors subequal, separated by a low transverse ridge.

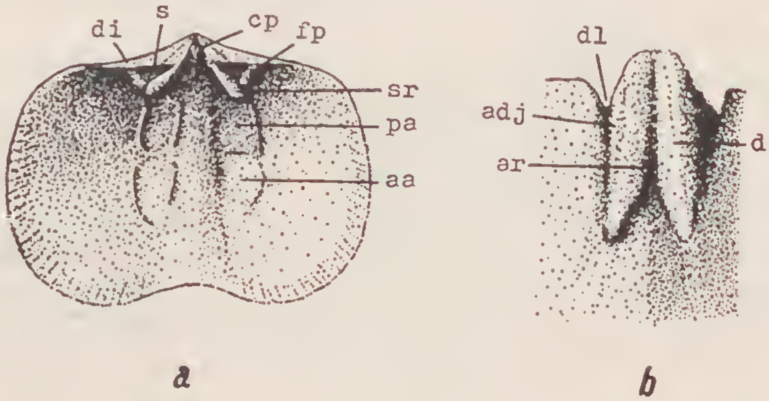

FIG. 12—*Isorthis festiva* sp. nov. (a) Dorsal interior based on a latex impression of M.3437; (b) Internal mould of dorsal valve of holotype M.3436. aa: anterior adductor impression, pa: posterior adductor impression, cp: cardinal process, di: dorsal interarea, fp: fulcral plate, s: socket, sr: socket ridge, adj: adjustor muscle impression, ar: adductor ridge, d: diductor muscle impression, dl: dental lamella. x 5 approx.

MEASUREMENTS: M.3436, l. = 13 mm, w. = 13 mm.

TYPE AND FIGURED SPECIMENS: Holotype M.3436, A-B, Loc. 47; M.3435, 7, Loc. 49, Boola Beds.

OCCURRENCE: Loc. 47 (occasional), 48 (rare), 49 (occasional), Boola Beds.

REMARKS: As far as can be judged from the existing material this species is a typical member of the Silurian and Devonian genus *Isorthis*. The ventral interior, however, is known only from one fragmentary specimen.

Schizophoria allani Shirley 1938 (p. 465-6, Pl. 41, fig. 1-3), from the Lower Devonian Baton R. Beds of New Zealand, undoubtedly represents another Australasian species of *Isorthis,* although Gill (1950), in identifying Shirley's species from the Bell Shale, Tasmania, referred it to the genus *Parmorthis* Schuchert and Cooper (= *Resserella* Bancroft). However Shirley's description and figures make it clear that the species is a schizophorid, and, on the basis of the dorsal musculature and cardinalia, a species of *Isorthis*. Whether or not the internal mould figured by Gill (Pl. 1, fig. 24) belongs to the genus *Isorthis* remains to be demonstrated; fulcral plates appear to be present in the specimen, but no figure or description is given of the ventral interior. Gill (1949) had previously described a further Australasian species of *Isorthis* from the Lower Devonian of Sandy's Cr., Gippsland, but this time in the Upper Devonian genus *Cariniferella* Schuchert and Cooper. Gill's figures show the form to be a schizophorid, and, as far as can be assessed without reference to type material, a typical species of *Isorthis*. In fact, from the somewhat sheared rocks of Sandy's Cr., Gill recognized two species—*Cariniferella alpha,* a narrow form, and *Cariniferella beta,* a wide form. These two 'species' are obviously based on secondary shape changes of the one form caused by deformation of the enclosing matrix. Thus, in a sense, it is fortunate that *C. beta* Gill is preoccupied by *C. beta* (Williams 1908), leaving but the one name for the Sandy's Cr. form. Similar shape variations can be seen in the figured specimens of *Isorthis allani* (Shirley 1938, cf. Pl. 41, fig. 1-2) and even in the Tyers dalmanellacids (e.g. *Resserella impensa*, Pl. 30, fig. 23-4).

Isorthis festiva differs from the other Australasian species most obviously in its larger dorsal muscle field. From the North American and European species it differs in the generally more bladed socket ridges and better developed dental lamellae, and the less well defined ventral adductor ridge.

Genus **Schizophoria** King 1850

Schizophoria sp. indet.

(Pl. XXXI, fig. 1-2)

Description: Dorsal valve strongly convex, with long straight hinge line, moderately high orthocline interarea, open notothyrium, and rounded anterior commissure.

Cardinalia large with inner socket ridges bladed and strongly divergent, supported by vertical plates and continued as high muscle bounding ridges. Cardinal process represented by a short ridge, perhaps with lower subsidiary ridges. Muscle area large, extending over half-way to the anterior commissure, with diductors separated by a low broad median ridge, not clearly differentiated into anterior and posterior scars. Sockets small and shallow, defined by low fulcral plates.

Surface of shell marked by multicostellate ornament.

Measurements: M.3433, l. = 20 mm, w. = 18 mm.

Figured Specimens and Occurrence: M.3433, Loc. 47, Boola Beds; M.3434, Loc. 49, Boola Beds, may also belong to this species.

Remarks: One single fragmentary internal mould of a dorsal valve of this species is present in the collection. An even more incomplete ventral interior from Loc. 49 may belong to the same species (Pl. XXXI, fig. 2). This shows a schizophorid muscle impression in which the median adductor ridge is wider and more sharply defined than that of either *Tyersella typica* or *Isorthis festiva*. The dental lamellae also appear to be less strongly developed than in those species. The material does not permit positive identification of the species.

Superfamily PENTAMERACEA Schuchert

Family PENTAMERIDAE McCoy

Genus **Gypidula** Hall 1867

'Gypidula' victoriae Chapman

(Pl. XXXI, fig. 7-8)

Gypidula victoriae Chapman 1913, p. 106-7, Pl. 11, fig. 12.

DESCRIPTION:

EXTERIOR—Outline longitudinally elliptical, with highly convex ventral valve. Hinge line short with maximum width of shell about midlength. Anterior commissure broadly crenulate, due to a ventral fold which bears a shallow sulcus on the anterior half of the valve. Umbo incurved over the low apsacline interarea. Delthyrium open. Surface with faint growth lines.

VENTRAL INTERIOR—Delthyrial cavity deep, teeth apparently blunt, dental lamellae posteriorly united into a short spondylium supported by a stout median septum which extends about one-quarter the distance to the anterior margin.

MEASUREMENTS: l. = 8 mm, w. = 5 mm.

FIGURED SPECIMEN AND OCCURRENCE: M.3438 A-B, Loc. 43, Boola Beds.

REMARKS: The single ventral valve from Tyers is undoubtedly conspecific with Chapman's species from Ruddock's Quarry, known from an incomplete internal mould of both valves. Although the ventral interior suggests the species is correctly assigned to *Gypidula*, positive identification is not possible till the dorsal interior is properly known.

Superfamily PLECTAMBONACEA Williams

Family LEPTESTIIDAE Williams

Genus **Plectodonta** Kozlowski 1929

Plectodonta bipartita (Chapman)

(Pl. XXXI, fig. 18-19)

Chonetes bipartita Chapman 1913, p. 104-5, Pl. 10, fig. 8-10.
Strophcodonta bipartita (Chapman) Gill 1942, p. 41, Pl. 5, fig. 7-9, Pl. 6, fig. 10.
Plectodonta bipartita (Chapman) Gill 1948b, p. 13; Gill 1950, p. 249, Pl. 1, fig. 21-3.
non Leptaena bipartita Hall 1852, p. 326, Pl. 74, fig. 4-5.
=*Stropheodonta bipartita* (Hall) *auct.* = *Leptostrophia bipartita* (Hall).

DESCRIPTION:

EXTERIOR—Small, semicircular shells with rounded outline and strongly concavo-convex profile. Hinge line long and straight, marking the greatest width of the shell; cardinal extremities angular. Anterior commissure rounded. Ventral interarea low and long, apsacline, with a triangular delthyrium apparently closed apically by a small pseudodeltidium. Dorsal interarea extremely low, hypercline, with the notothyrium closed by a tripartite structure probably representing a pair of chilidial plates anchylosed to the median cardinal process.

Surface ornament parvicostellate, with each valve bearing from about 14 to 20 coarser costellae between which marginally there may be as many as 7 finer costellae. These are crossed by irregularly spaced growth lines.

VENTRAL INTERIOR—Ventral valve with a small ventral process probably buttressing the pseudodeltidium at the posterior of the deep delthyrial cavity. Diductor scars ovate, widely diverging at an angle of about 45°, deeply impressed, and arising just anterior to the ventral process and extending about half-way to the anterior commissure. Adductors probably located in the angle between the divergent diductor scars and just anterior to their median junction. Inner surface papillose with the papillae strongly developed and radially aligned in a zone about 1 mm wide around the commissure. In this zone the stronger costellae of the exterior are represented as radial grooves. Hinge line denticulate over half-way to the cardinal extremities with about 10 denticles per mm.

DORSAL INTERIOR—Dorsal valves with a strong, probably trilobed structure filling the notothyrium (= chilidial plates + cardinal process?). Arising immediately anterior to this process is a narrow median furrow which extends most of the distance to the anterior commissure and shallows anteriorly. Inner socket ridges short but well developed, arising from each side of the fused dorsal process, strongly divergent, almost parallel to the hinge line. 4 septa present with the inner pair much more strongly developed than the outer pair. The high inner pair arise just anterior to the cardinalia, diverge at an angle of about 20°, and extend about three-quarters of the distance to the anterior margin. Outer pair arising well anterior to the cardinalia, close and almost parallel to the inner pair, but only about half their length. Curved 'lophophore platform' surrounding the septa variably developed and seen only on occasional specimens. Inner surface more strongly papillose than that of the ventral interior and with a similar marginal zone of smaller radially aligned papillae. Hinge line bearing sockets (?) for the ventral hinge denticles.

MEASUREMENTS: M.3447, l. = 4 mm, w. = 6 mm.

FIGURED SPECIMENS: M.3446-7, Loc. 43, Boola Beds.

OCCURRENCE: Loc. 25, Mudstone Phase, Coopers Creek Formation (?); Loc. 39 (rare), 40 (occasional), 41 (rare), 42 (rare), 43 (abundant), 44 (occasional), 45 (rare), 46 (rare), 47 (rare), 52 (occasional), 53 (rare), 54 (rare), Boola Beds.

REMARKS: Although Gill (1942), in wrongly assigning this species to the Devonian genus *Stropheodonta* Hall, made Chapman's trivial name a type of secondary homonym of *Stropheodonta* (*Leptostrophia*) *bipartita* (Hall), this does not require correction as, previously, Caster (1939) had established Hall's subgenus as a genus within its own right. Gill (*op. cit.*) gives this species as one of his zone fossils of the Yeringian which, he considered, indicate a Devonian age for the series. However, the genus *Plectodonta* is more typical of Silurian rocks elsewhere in the world.

Apart from differences in surface ornament *P. bipartita* differs from *P. mariae* Kozlowski, the type species of the genus, in the more posterior location of the ventral diductor impressions. This feature it shares with certain British Silurian species such as *Plectodonta millinensis* cf. var. *canastonensis* Jones (Lamont and Gilbert 1945, p. 659, Pl. 4, fig. 13-19). *P. bipartita* resembles most closely *P. davidi* (Mitchell) (Brown 1949, p. 199, Pl. 14, fig. 1-6) from the Silurian of Yass, N.S.W., particularly in the internal features of the ventral valve. *P. davidi*, however, apparently lacks the strong median furrow present in the dorsal valve which is so characteristic of *P. bipartita*. The species is widely distributed through the Boola Beds with its common associate *Lissatrypa lenticulata* sp. nov.

Genus **Notanoplia** Gill 1950

Notanoplia Gill 1950, p. 249 *et. seq.*

Gill (1950) proposed this genus to include a new species, *N. pherista*, from the Bell Shale, Tasmania, as well as two species previously described by him (1942) from the Yering Beds in the North American genus *Anoplia* (viz. *A. australis* and *A. withersi*). A further species, *N. loyolensis* Gill, from the Loyola district, has subsequently been described (Gill 1951b). Gill considered his genus to be very closely related to the North American chonetid *Anoplia*, so much so, that he regarded the genera as isochronous on the basis of their similarity (Gill 1950, p. 250). A review of the characters of the genus given below suggests that the genus represents a brachiopod with leptestiid affinities rather than a chonetid, and so the stratigraphic and palaeogeographic arguments based on the occurrence of the species of the genus may be discounted.

Review of the Features of *Notanoplia* Gill:

External Features—The species referred to the genus are all small, semicircular, plano-convex or slightly concavo-convex, comparatively smooth brachiopods. *N. australis* and *N. withersi* are described as smooth forms (Gill 1942) whilst *N. pherista* is 'smooth except for traces of radial costellae' sometimes crossed by concentric growth lines (Gill 1950, p. 251). This type of ornament is well developed in *Notanoplia* sp. described below (Pl. XXXI, fig. 16). There is a complete absence of spine bases and spines along the ventral interarea in *Notanoplia*. Cardinal spines are present in *Anoplia helderbergiae* but are usually considered to be absent in *A. nucleata* (Hall), the type species of *Anoplia* Hall and Clarke. It may be noted, however, that Hall and Clarke (1892, p. 293) state of this species. 'No external evidence of cardinal spines, though spine tubes exist in one or more pairs in the substance of the pedicle valve'. No comparable structures are present in any species of the genus *Notanoplia*. The shell material is as yet unknown in all species of *Notanoplia*.

Septation—The most striking feature in all species referred to the genus is the develoment of strong, blunt, almost platformed septa in each valve. In general, in the ventral valve there is a strong median septum, with two well developed secondary septa bisecting the angles between the median septum and the hinge line. In *N. withersi* there are two further subsidiary septa between the median septum and the secondary septa, while in *N. loyolensis* another pair of secondary septa is described. The most remarkable feature of this excess of septation is that each septum of the ventral valve has a corresponding septum in the dorsal valve in those species in which the dorsal interior is known. Although septa subsidiary to the median septum may be present in species of *Chonetes* they are always comparatively weakly developed and corresponding septa are not present in the opposing valve. The excess of strong septa is more characteristic of plectambonacids as a whole, and indeed similar septation is present in species of *Sowerbyella* although the dorsal median septum is typically absent (Jones 1928). The nature of the septa is of interest also. In *Chonetes* they are generally low and sharp, whereas in *Notanoplia* the septa, particularly the median septum, are high and platformed, suggesting that perhaps they were the seat of muscle attachment. The muscle impressions are unknown in all species.

Cardinalia—In the nature of the cardinalia the relationships of *Notanoplia* are clearest. In the Tyers specimens of *Notanoplia* sp. (described below) this consists of strong, divergent socket ridges anchylosed to what probably represents a combined cardinal process and chilidial plates. The components of this 'dorsal proccss' are not well defined in the Tyers specimens of *Notanoplia* sp. but one specimen suggests it is trilobed (Fig. 13b). Furthermore, Gill (1950) described the dorsal interior as possessing a 'trilobed cardinal process' in *N. pherista*. This type of cardinalia is completely foreign to chonetids but it is typical of the plectambonacid family Leptestiidae Williams and more particularly the subfamily Sowerbyellinae Öpik (*fide* Williams 1953b).

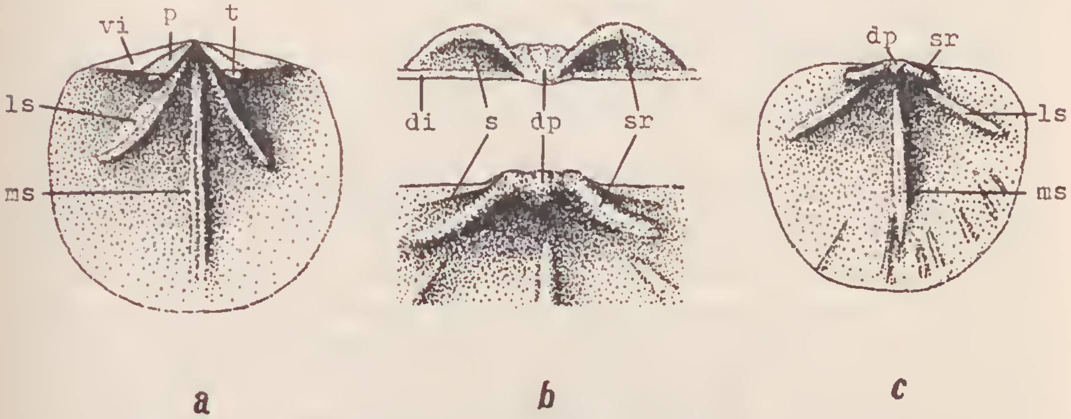

FIG. 13—*Notanoplia* spp. (a) *Notanoplia australis* (Gill). Ventral interior based on a latex impression of M.3439; x 5 approx. (b) *Notanoplia* sp. Posterior and ventral aspects of the cardinalia, based on a latex impression of M.3442; x 10 approx. (c) *Notanoplia* sp. Dorsal interior, based on a latex impression of M.3443; x 5 approx. ls: lateral septum, ms: median septum, p: perideltidium, t: tooth, vi: ventral interarea, di: dorsal interarea, dp: dorsal process, s: socket, sr: socket ridge. x 5 approx.

Thus it is considered that, rather than a chonetid closely related to *Anoplia*, *Notanoplia* represents an indigenous genus of leptestiid brachiopod. This conclusion must in a sense be regarded as provisional as the only dorsal interiors examined were of *Notanoplia* sp. from the Boola Beds. Material of the other species, in particular the type species *N. pherista* Gill, was not available for study.

Notanoplia australis (Gill)

(Pl. XXXI, fig. 9-10; Fig. 13a)

Anoplia australis Gill 1942, p. 38, Pl. 4, fig. 8; Gill 1945, p. 144.
Notanoplia australis (Gill) Gill 1951b, p. 64.

DESCRIPTION:

EXTERIOR—Ventral valve small, semicircular to subquadrate with rounded outlines and strongly convex profile. Greatest width slightly anterior of the long straight hinge line; cardinal extremities angular and anterior commissure rounded. Interarea comparatively high and apsacline, with the umbo strongly incurved, and with a widely triangular delthyrium which is apparently open. Outside the delthyrium is a perideltidium separated from the rest of the interarea by a perideltidial line which runs from the umbo to meet the hinge line slightly less than half-way to the cardinal extremities. Ornamentation of the interarea obscure. Surface smooth.

Ventral Interior—Delthyrial cavity deep, with 3 strong septa arising from near the apex of the valve. The median septum extends almost to the anterior commissure and is high and blunt and bears a groove toward its anterior end. The high lateral septa diverge at an angle of about 45° to the median septum and extend about half-way to the margin. Two moderately large triangular teeth are mounted each side of the delthyrium. Muscle impressions not visible on the smooth inner surface of the shell.

Dorsal valve not present in the Tyers material.

Measurements: M.3439, l. = 5 mm, w. = 5 mm.

Figured Specimen and Occurrence: M.3439, Loc. 47, Boola Beds (rare).

Remarks: The fragmentary specimens from the Boola Beds were found difficult to classify in terms of the existing species of *Notanoplia* as at present defined. Two species appear to be represented in the collection. The first, a comparatively small, smooth form, represented by a few, mostly fragmentary ventral valves, is apparently very close to the Yeringian species *N. australis* (Gill). The second, a larger form, approaches more closely *N. pherista* Gill from the Bell Shale, in that it possesses a surface ornament of subdued radial costellae crossed by concentric growth lines. Besides this it differs from *N. australis* in possessing a flatter ventral valve, lower, more divergent lateral septa in each valve and a marginal zone of well developed radial ridges on the insides of the valves. Most of these differences could conceivably have arisen from the secondary deformation and compaction of individuals of a single, variable species, particularly in view of the wide gradation there exists in these features. However, in view of the presence of surface ornament in the second form, it seems most likely that two species are present. *N. loyolensis* Gill 1951 (p. 53, fig. 1-4), based on a single ventral interior from Loyola, and probably from a similar horizon to that of the Boola Beds, is characterized by the possession of 7 septa. Some of these could represent the strongly developed internal radial ridges which are normally confined to the shell margins in the second form from Tyers described as *Notanoplia* sp. below. This form cannot be identified more positively, nor safely described as a new species till *N. loyolensis* is properly known and the other species of *Notanoplia* better defined.

Notanoplia sp.

(Pl. XXXI, fig. 11-17; Fig. 13b-c)

Description:

Exterior—Comparatively large *Notanoplia* with rounded to subquadrate outline and rounded anterior commissure, and with greatest width about midlength of the shell. Profile plano-convex, with the ventral valve gently convex. Hinge line long and straight with the cardinal extremities angular. Ventral interarea comparatively high and apsacline with umbo incurved over the hinge line and with an apparently open delthyrium. Dorsal interarea extremely low and hypercline with a small notothyrium closed by the 'dorsal process'.

Surface ornament of subdued well-spaced radial costellae crossed by irregularly spaced growth lines giving a reticulate appearance to the shell surface. About 50 costellae on each valve.

VENTRAL INTERIOR—Delthyrial cavity comparatively deep with three strong septa arising from near the apex of the valve. The wide blunt median septum extends almost to the anterior commissure and bears a well developed groove toward its anterior end. The lateral septa are much lower than the median septum and diverge at an angle of about 60° to the median septum. They extend about half-way to the margin. Two strong teeth are mounted on each side of the delthyrium. Inner surface of shell usually marked by a marginal zone of radial ridges.

DORSAL INTERIOR—Notothyrial cavity extremely shallow with short strong widely divergent socket ridges anchylosed posteriorly to a 'dorsal process' at the apex of the valve which probably consists of a pair of chilidial plates and a short-shafted cardinal process. Sockets shallow, poorly defined apart from the socket ridges. A high blunt median septum extends from immediately anterior of the cardinal process almost to the anterior commissure. Lateral septa similar to those of the ventral valve. Interior of the valve smooth or with occasional radial ridges toward the margins.

MEASUREMENTS: M.3444, l. = 6 mm, w. = 6·5 mm.

FIGURED SPECIMENS: M.3440, Loc. 36, Conglomerate Phase, Coopers Creek Formation; M.3441-5, Loc. 43, Boola Beds.

OCCURRENCE: Loc. 36 (rare), Conglomerate Phase, Coopers Creek Formation; Loc. 40 (rare), 43 (abundant), 45 (rare), Boola Beds.

Superfamily STROPHOMENACEA Schuchert

Family STROPHOMENIDAE King

Genus **Notoleptaena** Gill 1951

Notoleptaena Gill 1950, p. 253 (nomen nudum).
Notoleptaena Gill 1951a, p. 191 *et seq.*
? *Rugoleptaena* Havlíček 1956, p. 558-61.

Gill (1951a) proposed this genus to include two new species from the Lower Devonian of Victoria, although the name was employed in an earlier paper which inadvertently predated the generic description. Although this does not effect the genus *Notoleptaena*, in the same paper Gill 1950) a new species of *Notoconchidium*, *N. florenceusis*, was described and *Pentamerus tasmaniensis* Etheridge 1883 was referred to that genus. As this publication predates what was intended to be the original generic description, then the genus dates from 1950, and the choice of type species must lie between the two abovementioned species.

The genus *Notoleptaena* is to be distinguished from *Leptaena* in the configuration of the valves. Instead of the dorsally deflected trail of *Leptaena* the genus is described as possessing a ventrally deflected dorsal margin and a dorsally deflected ventral tongue. Furthermore, the dorsal valve is described as convex with an anterior gap for the reception of the ventral tongue. These features are seen in *N. linguifera*, the type species of the genus, but in the other Victorian species, *N. otophera*, the shape of the dorsal valve is as yet unknown. A similar configuration of the valves is seen in *Leptaena bouei* Barrande from Bohemia, Europe and Russia.

Havlíček (1956) has proposed a very similar genus *Rugoleptaena* which differs solely from *N. linguifera* in that the dorsal valve possess a dorsally deflected anterior margin. The species which Havlíček includes in his genus are *Rugoleptaena hornyi* Havlíček and *Leptaena emarginata* (Barrande). The actual configuration of the valves in these strophomenoids appears to be so variable (as with other strophomenoid groups) that probably the best procedure would be to regard the abovementioned species as congeneric till such times as they are better known. The forms appear to constitute a fairly close knit group, for crenulate teeth have been reported in *Leptaena emarginata* (Barrande) (Kozlowski 1929) with 'rugoleptaenid' valves, and in *N. otophera* Gill with apparently 'notoleptaenid' valves. It is unfortunate that the type species of *Notoleptaena* comes from the comparatively coarse sandstones of the Heathcote district so that the internal features are difficult to interpret. A precursor to the group is probably seen in such Silurian emarginate species as *Leptaena bella* Williams from the Llandovery of Wales.

Gill (1951a) in his discussion of the palaeo-ecology of *Notoleptaena* considered that the forms concerned were without a functional pedicle (as he did also of *Leptaena, contra* Williams 1953b). Although it appears that in *Leptaena emarginata* the pedicle probably atrophied during ontogeny, the specimens of *N. otophera* from the Boola Beds (preserved as moulds) show a thread of matrix extending from the ventral umbonal cavity to the enclosing matrix. This suggests that a functional pedicle was present at least in this species.

Notoleptaena otophera Gill

(Pl. XXXIII, fig. 12-13)

Notoleptaena otophera Gill 1951a, p. 200-3, Pl. 1, fig. 24-7.

DESCRIPTION:

EXTERIOR—Ventral valve slightly convex in the umbonal region, becoming planate and then with a strong sharp dorsal geniculation which is deepest along the anterior commissure where it forms a tongue. Certain specimens suggest that along the lateral commissure the shell may be sharply deflected ventrally before it is recurved dorsally, so that a raised margin may be developed. Ventral interarea low and apsacline with a well developed incurved umbo, apparently with an open pedicle foramen, and probably with the delthyrium closed by a narrow pseudodeltidium. Dorsal interarea extremely low, hypercline (or anacline), with a small notothyrium apparently closed by two chilidial plates which are fused to the cardinal process lobes. The socket ridges of the interior of the valve are continued across the dorsal interarea as two low ridges which converge beneath the insignificant dorsal umbo. Inner parts of the dorsal valve planate, margins not preserved. Outline alate, with greatest width along the straight hinge line; cardinal extremities pointed, anterior commissure broadly sulcate.

Surface of ventral valve with irregular concentric rugae, about 1 mm apart marginally, crossed by fine radial striations. Dorsal exterior poorly preserved.

VENTRAL INTERIOR—Muscle area longitudinally ovate, with a well-defined muscle bounding ridge. Adductors lanceolate, medianly mounted on a low ridge, diductors somewhat triangular. Two well developed crenulate teeth mounted each side of the delthyrium. Coarsely papillose 'genital area' each side of the muscle field. Ventral pallial sinuses aparently pinate, similar to those of *Leptaena.*

FIGURED SPECIMEN: M.3461 A-B, Loc. 47, Boola Beds.

OCCURRENCE: Loc. 40 (rare), 43 (occasional), 46 (rare), 47 (rare), (49 rare), 54 (rare), 56 (rare).

REMARKS: The internal features of this form are very similar to those of *Leptaena emarginata* (Barr.) as described by Kozlowski (1929).

Fragmentary specimens of another leptaenid were collected in the Limestone Phase of the Coopers Creek Formation. This form appears to belong to *Leptaena*; its occurrence is recorded in Table 1 where it is identified as *Leptaena* sp. indet.

Family STROPHEODONTIDAE Caster

Genus **Leptostrophia** Hall 1892

Leptostrophia sp. affin. **L. affinalata** (Gill)

(Pl. XXXII, fig. 1)

Affin. *Protoleptostrophia affinalata* Gill 1949, p. 100, Pl. 2, fig. 6; Pl. 3, fig. 19, 22.

DESCRIPTION:

EXTERIOR—Ventral valve slightly convex, semicircular or subquadrate in outline, with a long low apsacline interarea. Cardinal extremities quadrate or perhaps slightly alate; anterior commissure rounded. Delthyrium small, apparently closed by a very low pseudodeltidium. Surface poorly preserved but ornament apparently parvicostellate.

VENTRAL INTERIOR—Ventral process apparently very small and confined to the umbo of the valve. Muscle bounding ridges (= 'dental ridges' of Gill 1949, p. 100) diverging at an angle of about 45° and extending slightly less than half-way to the anterior commissure. Diductor scars triangular, set each side of the lanceolate adductors which in turn are separated by an obscure median ridge. 'Genital areas' each side of the muscle field coarsely papillose, with the pseudopunctae (= 'taleolae') smaller and radially aligned toward the shell margins. Hinge line denticulate for most of its length with about 5 or 6 denticles per mm.

Dorsal valve not identified in the collection.

MEASUREMENTS: M.3448, l. = 16 mm, w. (inferred) = 23 mm.

FIGURED SPECIMEN AND OCCURRENCE: M.3448, Loc. 47, Boola Beds (rare).

REMARKS: Gill (1948, 1949, 1950) has described various species in the Devonian genus *Protoleptostrophia* Caster from localities in Tasmania and Victoria, as well as referring the Yeringian species *Stropheodonta* (*Leptostrophia*) *alata* Chapman 1903 (p. 69, Pl. 11, fig. 6-7) to that genus. However, in all cases where the material permits positive identification, these records are based on species of *Leptostrophia*. In '*Protoleptostrophia*' *affinalata* Gill described the cardinal process as 'quadrifid' with two large central prongs on either side of which are much smaller ones. This type of structure, which Williams (1953a) showed to consist of the normal bilobed stropheodontid cardinal process and subsidiary socket plates which move adjacent to the cardinal process during the development of the leptostrophid stock, is completely characteristic of the genus *Leptostrophia*. On the other hand, *Protoleptostrophia* lacks the socket plates and so possesses a simple elongate bilobed cardinal process. It may be noted that Gill (1949) gives the time range of the genus *Leptostrophia* as Lower Devonian, but it appears first in lower Llandovery times (Williams 1951) and ranges through to the end of the Lower Devonian.

Although very similar to *L. affinalata*, from Sandy's Cr., the Boola form differs in a number of respects, certain of which, in terms of Williams's (1953a) concept of the development of the leptostrophid stock, suggest that the Boola form is the more primitive. Thus the figures of *L. affinalata* show the species to possess a well developed ventral process continued anteriorly as a well defined ridge. Strong process pits are also visible in the figures. In contrast to this in the Boola form the ventral process and process pits are poorly defined. A more significant distinction is that the hinge line is more closely denticulate in the Boola form. *L. alata* (Chapman) from the Yering Beds, apparently possesses more widely divergent muscle bounding ridges, but Chapman's description and figures make comparisons with that species difficult.

Leptostrophia sp. cf. **L. explanata** (Sowerby)

(Pl. XXXII, fig. 2-3)

Cf. *Leptaena explanata* Sowerby 1842, p. 409, Pl. 38, fig. 15.
Cf. *Strophcodanta* (*Leptastrophia*) *explanata* (Sowerby) Maillieux 1936, p. 66-71 (*cum syn.*).
? *Leptastrophia explanata* (Sowerby) Shirley 1938, p. 468, Pl. 41, fig. 7-9.
? *Rhytostraphia shirleyi* Allan 1942, p. 146.

DESCRIPTION:

EXTERIOR—Ventral valve large, slightly convex and semicircular in outline, with greatest width along the straight hinge line; cardinal extremities rounded to slightly alate. Interarea long, low and apsacline with a wide delthyrium partly closed by a low pseudodeltidium. Anterior commissure rounded.

Radial ornament parvicostellate, with strong irregularly spaced primary costellae about 1 or 2 mm apart toward the anterior commissure and usually separated by about 5 secondary costellae. Radial ornament crossed by subdued concentric rugae, which are more strongly developed toward the margins where they are about 2·5 mm apart.

VENTRAL INTERIOR—Ventral process small, buttressing the low pseudodeltidium, and discontinuous with a low median ridge which divides the ventral muscle field. Muscle bounding ridges high, diverging at an angle of about 90°, and fading anteriorly. They outline broadly triangular diductor impressions which are difficult to delineate from the narrow adductors. 'Genital area' on each side of the muscle field strongly tuberculate, with tubercles encroaching on the muscle bounding ridges. Hinge line denticulate for most of its length with the denticles spaced at about 4 per mm.

Dorsal valve not represented in the collection.

MEASUREMENTS: M.3449, l. = 29mm, w. (inferred) = 43 mm.

FIGURED SPECIMEN AND OCCURRENCE: M.3449 A-B, Loc. 36, Conglomerate Phase, Coopers Creek Formation.

REMARKS: Shirley (1938) identified this widespread European Lower Devonian species in the fauna of the Baton R. Beds, New Zealand. Allan (1942) renamed the Baton R. form '*Rhytostrophia shirleyi*' on the basis of the surface ornament in which subdued concentric growth rugae may be present, but as Williams (1953a) points out, this is of little consequence as a taxonomic feature in stropheodontids. Whether or not the New Zealand form is distinct from the European species is not clear so the single ventral valve from Tyers is compared with the better established European species. The ventral interior of *L. explanata* differs from that of other large species of *Leptostrophia* such as *L. magnifica* (Hall) in the very widely divergent muscle bounding ridges.

Genus **Strophonella** Hall 1879

Strophonella gippslandica sp. nov.

(Pl. XXXII, fig. 4-5)

DIAGNOSIS: Large, gently resupinate *Strophonella* with a large ventral muscle field and very widely spaced radial costellae.

DESCRIPTION:

EXTERIOR—Ventral valve semicircular in outline with a long straight hinge line and slightly alate cardinal extremities. Profile gently resupinate, with the posterior half of the valve convex. Ventral interarea long, low and apsacline, marked by faint vertical striations each side of the comparatively well developed umbo. Delthyrium partly closed by a low pseudodeltidium.

Surface of the valve with about 50 well spaced radial costellae which may reach over 2 mm apart before a further costella is intercalated. This ornament is apparently a modification of the typical stropheodontid parvicostellate ornament in which the secondary costellae have been lost leaving only the widely spaced primary costellae. This does not appear to be due merely to the preservation of the specimens as fine growth lines can be seen crossing the primary costellae.

VENTRAL INTERIOR—Cardinal process pits well defined on each side of the ventral process which supports the low pseudodeltidium and is prolonged anteriorly as a fine median ridge extending about half-way down the muscle field. Muscle impressions large and subquadrate, extending almost half-way to the anterior commissure and outlined anteriorly and laterally by a strong petalloid muscle bounding ridge. Adductor scars longitudinally ovate, extending about half-way down the muscle field and included by the diductors. Inner surface of the shell strongly papillose around the muscle area with the papillae finer and radially aligned marginally. Hinge line denticulate for about half the length with the denticles closely spaced at approximately 6 per mm. Dental lamellae absent.

MEASUREMENTS: M.3450, l. = 22 mm, w. = 35 mm.

TYPE AND FIGURED SPECIMENS: Holotype M.3450 (ventral valve); M.3451, both from Loc. 47, Boola Beds.

OCCURRENCE: Loc. 47 (occasional), 49 (rare), Boola Beds.

REMARKS: Although a dorsal valve of this species was not represented in the collection it was decided to name this form as it clearly is a species of *Strophonella S.S.* and is well characterized by the features of the ventral valve. Among the Australian species of *Strophonella* it is most closely allied to *S. australiensis* Gill 1948, from Tasmania, from which it differs most obviously in the proportionally larger ventral muscle field. A very closely related form has been collected from Melbourne Hill in the Yering Beds. It may be noted in passing that *Strophonella lyelli* Gill 1948 (p. 64, Pl. 8, fig. 32-4, 41) does not appear to be a species of *Strophonella* but probably represents a new stropheodontid genus.

Genus **Maoristrophia** Allan 1947

Maoristrophia sp.

(Pl. XXXIII, fig. 14-15)

DESCRIPTION:

EXTERIOR—Ventral valve slightly convex, semicircular in outline with quadrangular cardinal extremities and rounded anterior commissure and with greatest width along the straight hinge line. Interarea apsacline, comparatively high beneath the umbo which is incurved over the hinge line. Delthyrium open or perhaps closed by a low pseudodeltidium.

Surface with about 100 coarse, somewhat fascicostellate costellae which are marginally spaced at about 4 per mm.

VENTRAL INTERIOR—Low curved muscle bounding ridges arise each side of the shallow delthyrial cavity and diverge at angle of about 90°. These extend about one-third of the distance to the commissure and fade anteriorly. Muscle impressions obscure. Inner surface strongly papillose with the papillae radially aligned marginally.

Hinge line denticulate each side of the delthyrium for about one-third of the distance to the cardinal extremities. Denticles spaced at about 5 per mm and extending on to the ventral interarea as low ridges.

Dorsal valve unknown.

FIGURED SPECIMEN AND OCCURRENCE: M.3462, Loc. 36, Conglomerate Phase, Coopers Creek Formation.

REMARKS: The single fragmentary ventral valve clearly belongs to the genus *Maoristrophia* although it differs from the other species of the genus described by Allan (1947) and Gill (1952) in apparently lacking a well defined ventral sulcus.

Genus **Megastrophia** Caster 1939

Megastrophia (?) sp.

(Pl. XXXII, fig. 6)

One single ventral valve of this form was collected from Loc. 11, Limestone Phase, Coopers Creek Formation. It is figured here as it represents one of the few comparatively complete brachiopod valves collected from localities in the massive limestone. The specimen is questionably referred to the genus *Megastrophia* on the basis of its large size and strong convexity. The parvicostellate ornament, crossed by closely spaced, well developed growth lines, is also characteristic of that genus. The specimen also shows a tendency to develop irregular concentric rugae.

A further stropheodontid was represented in the collection by various fragments of 'cymostrophid' ornament. Although too fragmentary to warrant description, the occurrence of this form is shown in Table 1 where it is identified as *Cymostrophia* sp. indet.

Superfamily CHONETACEA Shrock & Twenhofel

Family CHONETIDAE Hall & Clarke

Genus **Chonetes** Fischer de Waldheim 1837

Chonetes cresswelli Chapman

(Pl. XXXII, fig. 7-9)

Chonetes cresswelli Chapman 1903, p. 77-8, Pl. 12, fig. 7.
Chonetes (Chonetes) cresswelli Chapman, Gill 1945, p. 134-5, Pl. 8, fig. 5.
Chonetes cresswelli Chapman, Gill 1951b, p. 60, Pl. 3, fig. 5; Fig. 2.

DESCRIPTION:

EXTERIOR—Ventral valve small, semicircular, with rounded anterior commissure, quadrate cardinal extremities and with greatest width along the straight hinge line or slightly anterior to it. Profile slightly convex. Ventral interarea extremely low and bearing 3 (or 4 ?) hollow, fairly slender spines each side of the umbo which are (at least the outer spines) directed back toward the umbo at an angle of about 45° to the hinge line. Delthyrium apparently open or modified by a low pseudodeltidium.

Surface marked by evenly spaced radial costellae with about 56 around the commissure of a large specimen and spaced at about 5 per mm.

VENTRAL INTERIOR—Two small teeth are mounted each side of the delthyrium and a short strong median septum extends from the umbo about one-quarter of the distance to the anterior commissure. Muscle impressions obscure. The interior of the valve is strongly papillose with the papillae radially aligned marginally following the radial costellae.

Dorsal valve not represented in the collection.

MEASUREMENTS: M.3454, l. = 5 mm, w. = 8 mm; M.3455, l. = 6 mm, w. = 7 mm.

FIGURED SPECIMENS: M.3453-5, Loc. 43, Boola Beds.

OCCURRENCE: Loc. 43 (occasional), 48 (rare), Boola Beds.

REMARKS: This form approaches closely *C. cresswelli* although the outer cardinal spines are directed in towards the umbo, a feature not seen typically in that species. The specimens, preserved as moulds, in general do not show the cardinal spines at all well, although 4 appear to be present on each side of the umbo. One specimen in particular (Pl. XXXII, fig. 7) appears to show only one spine on each side of the umbo and it was this particular specimen which was identified as *Chonetes ruddockensis* Gill elsewhere (Phillip 1960b). However, in all probability this appearance is due to the manner in which the specimen has been broken out of the matrix.

Fragments of a further species of *Chonetes* were also collected in the Limestone Phase of the Coopers Creek Formation. In the convexity of the ventral valve and the coarser surface ornament this form approaches more closely *C. robusta* Chapman. The material is too poor to warrant description but the occurrence of this form is recorded in Table 1 as *Chonetes* sp.

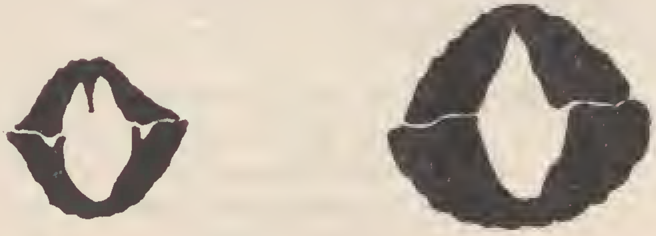

FIG. 14—*Uncinulus* (?) sp. Two transverse serial sections near the umbos of M.3456, separated by 1·2 mm. x 3 approx.

Superfamily RHYNCHONELLACEA Schuchert

Family CAMAROTOECHIIDAE Schuchert & Le Vene

Genus **Uncinulus** Bayle 1878

Uncinulus (?) sp.

(Pl. XXXIII, fig. 1-3; Fig. 14)

DESCRIPTION:

EXTERIOR—Outline transversely elliptical with greatest width just posterior to midlength of the shell. Profile biconvex with the dorsal valve more strongly arched. Hinge line short with the cardinal margins rounded. Ventral valve with a well developed tongue so that the anterior commissure is broadly uniplicate.

Surface of both valves with about 50 rounded plications which become wider and better defined as they approach the commissure. Both valves almost smooth in the umbonal regions. Usually about 10 plications in the ventral tongue.

MEASUREMENTS: M.3456, l. = 18 mm, w. = 25 mm, h. = 13 mm.

FIGURED SPECIMEN: M.3456, Loc. 15 Limestone Phase, Coopers Creek Formation.

OCCURRENCE: Loc. 1 (rare), 3 (rare), 11 (rare), 15 (occasional), 20 (rare), 21 (rare), 27 (rare), Limestone Phase; Loc. 31 (rare), 34 (rare), Conglomerate Phase, Coopers Creek Formation.

REMARKS: Although widely distributed through the Coopers Creek Formation, only one comparatively complete specimen of this form was collected, and even this specimen lacked the umbos of both valves. In an endeavour to arrive at some idea of the correct generic placement of this form the posterior end of the shell was ground to give two well spaced serial sections (Fig. 14). These proved difficult to interpret, but in the dorsal valve there is what appears to be a short median septum at the posterior end of a widely cleft hinge plate. A full interpretation of these internal features cannot be given till more suitable material is available for study. As they are known at present, a close similarity to the genus *Latonotoechia* Havlíček 1960 is indicated.

Large rhynchonellacids very similar in external morphology to the form are known from the Lower Devonian elsewhere in Victoria. The Lilydale form identified as *Eatonia (Eatonia)* affin. *bithynica* by Gill (1952) (= ? *Uncinulus stricklandi* Sowerby of Chapman 1903, p. 78) apparently represents a species of *Plethorhyncha* Hall and Clarke. Although the Tyers form appears to be a new species it seems best not to name it until its internal characters are better known and it can be properly compared with other Victorian forms.

Superfamily ATRYPACEA Schuchert & Le Vene

Family ATRYPIDAE Gill

Genus **Atrypa** Dalman 1828

Atrypa sp. cf. **A. reticularis** (Linnaeus)

(Pl. XXXIII, fig. 4-10)

? *Atrypa reticularis* var. *decurrens* Chapman 1913, p. 107, Pl. 11, fig. 13.

DESCRIPTION:

EXTERIOR—Shell rounded or longitudinally oval in outline, in lateral profile unequally biconvex with the dorsal valve more strongly convex. Greatest width usually half-way between the midlength of the shell and the short hinge line. Ventral sulcus variably developed; where strongly developed it becomes more marked anteriorly so that the anterior commissure may be strongly sulcate. The ventral umbo is prominent and strongly incurved so that the short interareas are obscured.

The surface is marked by strong rounded costae which are spaced at about 7 in 5 mm with an adult valve bearing about 60 such costae. They are crossed by well spaced growth lamellae which become more crowded toward the anterior commissure.

VENTRAL INTERIOR—Delthyrial cavity deep with a narrow furrow arising from the umbo. This expands into a triangular depression divided medianly by a low ridge. The depression broadens and shallows anteriorly and probably represents the site of the adductor muscles. They extend about half-way to the anterior end of the ventral muscle field and are not clearly separated in front from diductor impressions. Diductor impressions large and flabellate, arising just anterior and lateral to the posterior end of the adductor impressions and extending about half-way to the anterior commissure. They appear to meet in front of the adductor scars. The whole muscle field is scored by radiating grooves. The teeth are strong, somewhat triangular, well separated and mounted toward the extremities of the short hinge line and supported by very short stout dental lamellae. Each side of the muscle field the floor of the valve is strongly pitted, probably representing the genital area.

DORSAL INTERIOR—Cardinal process absent with 2 stout divergent crural bases anteriorly outlining the rather deep sockets. The cardinalia, mounted on a posterior thickening of the shell, thus forms a sessile cleft hinge plate. Adductor scars large, longitudinally ovate and strongly incised and well separated medianly by a low ridge. Separation into anterior and posterior impressions not visible. The muscle field extends about half-way to the anterior commissure, with a strongly pitted genital area on each side. The muscle impressions are deeply but irregularly scored.

MEASUREMENTS: M.3457, l. = 17 mm, w. = 17 mm, h. = 12 mm.

FIGURED SPECIMENS: M.3457-8, Loc. 48, Boola Beds; M.3433, 59, Loc. 47, Boola Beds.

OCCURRENCE: Loc. 1 (rare), 8 (rare), 11 (rare), 15 (rare), Limestone Phase; Loc. 31 (rare), 32 (occasional), 34 (occasional), 35 (rare), 36 (occasional), 37 rare), Conglomerate Phase, Coopers Creek Formation; Loc. 47 (occasional), 49 (common), Boola Beds.

REMARKS: This form is very close to *Atrypa reticularis* (Linnaeus) as described by Alexander (1949). It differs from that species in its more round or longitudinally oval outline with the greatest width of the shell generally more toward the anterior. Internally the teeth are more widely separated and there appear to be minor differences in the ventral musculature. Although the form resembles closely many overseas forms externally (e.g. *Atrypa petosequa* Fenton and Fenton 1930, p. 7, Pl. 1, fig. 1-8), from the point of view of local stratigraphy, it would probably be best to recognize this form as a local subspecies of *A. reticularis*. This, however, cannot be safely done till the types of *A. reticularis decurrens* are restudied. The single small (ventral ?) exterior from Ruddock's Quarry figured by Chapman possesses a similar number of costae to a specimen of the Tyers form of the same dimensions. It would be unwise to consider the two forms to be identical on the basis of this alone, so the matter is best left in abeyance. Chapman records his variety from Loyola, probably from a similar horizon to that of the Boola Beds.

Atrypa fimbriata (Chapman)

(Pl. XXXIV, fig. 1-3)

Atrypa fimbriata Chapman 1913, p. 109, Pl. 11, fig. 15.
Karpinskya ? fimbriata (Chapman) Gill 1942, p. 1.
non Atrypa fimbriata (Phillips) Sowerby 1840, p. 16, Pl. 617, fig. 4.

DESCRIPTION:

EXTERIOR—Ventral valve moderately convex with short low interarea and strongly incurved umbo. Outline longitudinally oval with greatest width just anterior to the hinge line. Anterior commissure rounded.

Surface marked by about 10 or 12 rounded radial ribs which are strongly developed medianly but fade laterally. These are crossed by well spaced, high growth lamellae which become progressively further apart away from the umbos and are over 1 mm apart around the anterior commissure. The ribs appear to have a tendency to be continued as marginal spines, but these are not preserved in either of the Tyers specimens.

VENTRAL INTERIOR—Delthyrial cavity deep with 2 small teeth mounted on short thick diverging dental lamellae. Muscle impressions obscure with the inner surface of the valve marked by the internal reflection of the strong surface ornament.

Dorsal valve not represented in the collection.

MEASUREMENTS: M.3463, l. = 7 mm, w. = 6 mm.

FIGURED SPECIMEN AND OCCURRENCE: M.3463, Loc. 47, Boola Beds.

REMARKS: The 2 ventral valves from Tyers agree closely with Chapman's figure of *A. fimbriata* although the concentric lamellae are closer in the Tyers specimen. Gill (1942) questionably referred Chapman's species to the Lower Devonian genus *Karpinskya* on the basis of the short median septum in the dorsal valve. The species, however, is typical of the genus *Atrypa*, and may be placed with those placed in the genus *Spinatrypa* Stainbrook 1951 on the basis of the surface ornament.

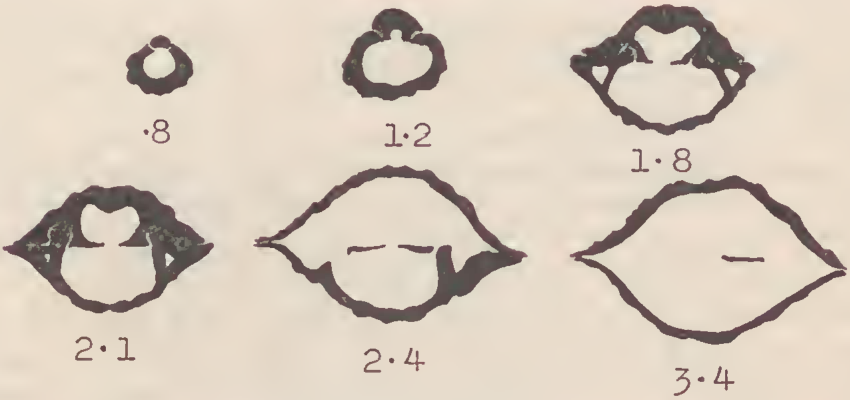

FIG. 15—*Plectatrypa australis* sp. nov. Transverse serial sections. The number beneath each figure refers to the distance each section is from the posterior end of the shell. x 3.

Genus **Plectatrypa** Schuchert & Cooper 1930

Plectatrypa australis sp. nov.

(Pl. XXXIV, fig. 5-9; Fig. 15)

DIAGNOSIS: *Plectatrypa* with moderately coarse plications and bearing about 5 plicae in the broad ventral sulcus.

DESCRIPTION:

EXTERIOR—Outline rounded to subquadrate with a prominent ventral umbo incurved over the short hinge line. Position of greatest width variable but usually about midlength of the shell. Lateral profile equally biconvex. Ventral valve with a well defined sulcus which becomes more strongly developed anteriorly so that the anterior commissure is broadly sulcate.

Both valves marked by fairly low rounded fasciculate plications. Ventral sulcus with 4 or, more usually, 5 plications. A large valve may bear up to 30 plications marginally which are spaced at about 1 or 2 per mm around the commissure. Away from the median zone of the shell the plications become progressively recurved toward the lateral commissure. Radial ornament crossed by fine, regularly spaced growth lines about 4 per mm.

Ventral Interior—Ventral interior with strong rounded teeth which articulate with deep dorsal sockets and are supported beneath by short strong diverging dental lamellae which originate a short distance from the umbo. Muscle area poorly defined, apparently triangular in shape arising from the deep delthyrial cavity and extending about one-third the distance to the anterior commissure.

Dorsal Interior—Notothyrial cavity deep with a low median ridge arising just anterior of the umbo and extending a short distance down the floor of the valve. Hinge plate widely cleft with deep sockets bounded laterally by the valve wall and medianly by strong crural bases. Arising from the anterior end of the crural bases are the ribbon-like crura which apparently supported the spires. Spires not observed in any specimens.

Measurements: M.3471, l. = 13 mm, w. = 14 mm, h. = 6 mm.

Type and Figured Specimens: Holotype M.3471, M.3469, Loc. 48; M.3470, Loc. 47, Boola Beds.

Occurrence: Loc. 47 (rare), 48 (occasional), Boola Beds.

Remarks: This species is very similar internally to *P. marginalis* (Dalman) as described by Poulson (1943). The only distinction which can be seen is in the thicker crural bases and dental lamellae which appear to be continued further anteriorly in *P. australis*. The surface ornament, however, characterizes the new species. It is coarser than that of *P. marginalis* but not so coarse as that of *P. groenlandica* (Poulsen 1943, p. 46, Pl. 5, fig. 17-23) from the Silurian of Greenland. Thus it approaches more closely some of the North American species, in particular *Plectatrypa brownsportensis* Amsden 1949 (p. 64, Pl. 34, fig. 2-3, 8-10)

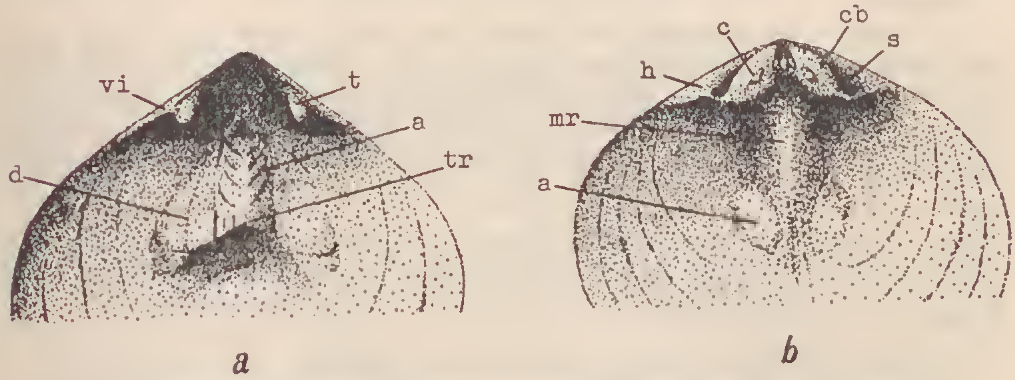

Fig. 16—*Lissatrypa lenticulata* sp. nov. (a) Ventral interior from latex impression of M.3465; (b) Dorsal interior from latex impression of holotype M.3467. a: adductor muscle impression, d: diductor muscle impression, t: tooth, tr: apex of triangular muscle platform, vi: ventral interarea, c: crus, cb: crural bases, h: cleft hinge plate, mr: median ridge, s: socket. x 5 approx.

from which it may be distinguished by the presence of a greater number of plications in the ventral sinus. The genus *Plectatrypa* is represented elsewhere in Australia in *Atrypa marginalis* Dalman of Mitchell and Dun (1920), from the Silurian of Yass, N.S.W. *Plectatrypa* appears to be confined to rocks of Silurian age elsewhere in the world.

Genus **Lissatrypa** Twenhofel 1914

Lissatrypa lenticulata sp. nov.

(Pl. XXXIV, fig. 4, 17-21; Fig. 16)

DIAGNOSIS: *Lissatrypa* with extremely low interareas and a poorly developed dorsal septum.

DESCRIPTION:

EXTERIOR—Shells with rounded to longitudinally oval outline, sometimes almost subquadrangular. Lateral profile equally biconvex. Hinge line short with rounded cardinal extremities; greatest width of shell usually about midlength or slightly posterior. Ventral interarea extremely low and curved, probably with an open delthyrium and perhaps with an open pedicle foramen at the apex of the comparatively well developed ventral umbo. Dorsal interarea virtually absent. Ventral valve with a variably developed sulcus so the anterior commissure may be widely sulcate.

Surface of both valves with well spaced growth lamellae about 1 mm apart but becoming more distant anteriorly. These are present also on the inner surfaces of the valves.

VENTRAL INTERIOR—Delthyrial cavity bounded by 2 lateral callosities which buttress the well developed teeth mounted just anterior to the interarea. A high triangular muscle platform arises just anterior of the umbo and extends about one-quarter of the distance to the anterior commissure. Mounted medianly on this are 2 elongate adductor muscle tracks while to each side larger, more flabellate deductor scars are present. Vague traces of the ventral pallial sinuses can be seen arising from the anterior of the muscle platform. Their pattern is pinnate, similar to that of *Coelospira.*

DORSAL INTERIOR—Dorsal interior with a heavy cleft sessile hinge plate. The crural bases are high and widely divergent and are incurved back over the deep elongate sockets which they define anteriorly. They bear two small projections on their apices which probably represent the crura. Nestled between the crural bases just anterior to an umbonal depression is a small protuberance. This is seen only in some of the specimens. The hingle plate is continued anteriorly as a low broad median ridge which extends about one-third of the distance to the anterior commissure. 2 small longitudinally ovate adductor scars are mounted close together each side of this median ridge at its anterior end. They tend to constrict the anterior end of the median ridge which, between the muscle impressions, may bear a shallow furrow.

MEASUREMENTS: M.3467, l. = 12 mm, w. = 12 mm.

TYPE AND FIGURED SPECIMENS: Holotype M.3467 (dorsal valve); M.3464-6, 8, Loc. 43, Boola Beds.

OCCURRENCE: Loc. 25 (rare), Mudstone Phase, Coopers Creek Formation; Loc. 39 (rare), 40 (occasional), 41 (rare), 42 (rare), 43 (common), 44 (rare), 45 (rare), 46 (rare), 47 (rare), 50 (rare), 51 (occasional), 52 (occasional), 53 (rare), 57 (rare), Boola Beds.

REMARKS: This rather variable species agrees closely with the internal features of *Lissatrypa atheroidea* Twenhofel, the generally accepted type species of *Lissatrypa*, as described by Kirk and Amsden (1952). One distinction is in the septum of the dorsal valve, which in *L. lenticulata* is represented by a broad low ridge. This feature, together with the extremely low interareas, serves to distinguish *L. lenticulata* from other species of *Lissatrypa*. Otherwise, the species is very close to such North American forms as *L. decaturensis* Amsden 1949 (p. 64, Pl. 9, fig. 16-23) from the Silurian of Tennessee.

The small projections mounted on the apices of the crural bases in some specimens of *L. lenticulata* probably represent the crura (Fig. 16b). Thus their location is similar to those of *L. atheroidea* as shown by Kirk and Amsden. On the other hand Kozlowski (1929, Fig. 54) shows the crura arising from the outer sides of the crural bases in his *L. leprosa*.

The genus *Tyrothyris* Öpik 1953, based on *T. tyro*, from the Llandovery of Heathcote, Victoria, is a genus which approaches *Lissatrypa* very closely in its internal features, but the two species described by Öpik in this genus were considered to be punctate. Although his material was preserved as moulds, there appears to be no *a priori* reason for doubting Öpik's interpretation; all known punctate stocks (excepting the terebratuloids) closely parallel a related impunctate stock and punctate *Atrypas* are known elsewhere (e.g. *Punctatrypa* Havlíček 1953). The shell material of *Lissatrypa lenticulata*, needless to say, is impunctate.

In this context mention should be made of *Nucleospira australis* McCoy 1874. Öpik (1953) has suggested that one of the figured specimens is perhaps a species of *Tyrothyris*. It could also represent a species of *Lissatrypa*.

Atrypoidea Mitchell and Dun 1920, a genus of smooth *Atrypa* from the Silurian of Yass, N.S.W., although imperfectly known, in all probability is a synonym of the genus *Atrypella* Kozlowski 1929.

Superfamily SPIRIFERACEA Waagen

Family SPIRIFERIDAE King

Genus **Eospirifer** Schuchert 1913

Eospirifer sp. affin. **E. togatus** (Barrande)

(Pl. XXXIV, fig. 14-16)

Affin. *Spirifer togatus* Barrande 1848, p. 167, Pl. 15, fig. 2.

Affin. *Eospirifer togatus* (Barrande), Shirley 1938, p. 477, Pl. 43, fig. 8-14; Havlíček 1959, p. 41, Pl. 7, fig. 1-6 (*cum syn.*).

DESCRIPTION:

EXTERIOR—Ventral valve large and transversely oval in outline and moderately convex with a prominent umbo incurved over the short interarea. Interarea concave, fairly high and triangular with a large, apparently open delthyrium. Greatest width usually about midlength of the shell. Ventral valve with a wide sulcus so that the anterior commissure is broadly sulcate. Flanks of the shell lacking plications. Surface with broad rounded costellae spaced at about 20 in 5 mm.

VENTRAL INTERIOR—Ventral interior with 2 extremely long high dental lamellae which extend three-quarters of the distance to the anterior commissure and bear small teeth adjacent to the interarea. Muscle impressions obscure on the floor of the deep delthyrial cavity. Some specimens show a low ridge at the posterior end of the delthyrial cavity whilst others show a vague trace of large flabellate diductors (?) between the anterior ends of the dental lamellae.

Dorsal valve with a broad fold corresponding with the ventral sulcus; internal features unknown.

MEASUREMENTS: M.3475, l. = 14 mm, w. = 19 mm.

FIGURED SPECIMENS: M.3474, 6, Loc. 48; M.3475, Loc. 49, Boola Beds.

OCCURRENCE: Loc. 11 (rare), 15 (rare), 26 (rare), Limestone Phase, Coopers Creek Formation; Loc. 43 (rare), 48 (occasional), 49 (rare), Boola Beds.

REMARKS: This species is identified with *Eospirifer togatus* on the basis of the strong dental lamellae, the absence of gentle ribs on the flanks of the shell and the rounded ventral sulcus. In fact the dental lamellae are stronger than in Barrande's species and the surface ornament is slightly coarser. It seems best not to recognize this form as a new species till the internal features of the dorsal valve are known.

Eospirifer parahentius Gill 1950 (p. 247, Pl. 1, fig. 1-6) from the Bell Shale, Tasmania, appears to represent a closely related species with shorter dental lamellae.

All the various fragmentary specimens of *Eospirifer* from Tyers are placed in the one form, but it is possible that more than one species is represented in the collection.

Genus **Delthyris** Dalman 1828

Subgenus **Howellella** Kozlowski 1946

Delthyris (Howellella) scabra sp. nov.

(Pl. XXXIV, fig. 10-13, 22; Pl. XXXV, fig. 18)

DIAGNOSIS: Small *Howellella* with weak dental lamellae, a high ventral interarea, and a deep, broadly rounded ventral sulcus with usually 3 lateral plications on each side of the sulcus, the outer 2 of which are poorly defined.

DESCRIPTION:

EXTERIOR—Outline transversely oval with a straight hinge line about two-thirds the maximum width of the shell which is approximately at the midlength. Cardinal extremities well rounded; anterior commissure gently sulcate. Lateral profile biconvex with the ventral valve deeper and more strongly arched. Ventral umbo prominent and incurved over the high concave ventral interarea which has a wide, apparently open delthyrium. Dorsal umbo insignificant. Ventral valve with a deep smooth sulcus about one-third the width of the shell; dorsal valve with a corresponding high fold. Both of these originate from the umbos of the respective valves. Lateral plications variable in number, usually with 3 plications on each side of the ventral sulcus and 2 on each side of the dorsal fold, but the outer plications are low and poorly defined. Surface of both valves with fine concentric growth lamellae spaced at about 5 per mm with transversely mounted spines spaced at about 16 per mm in their interspaces.

INTERIOR—Ventral valve with 2 very short, somewhat oblique dental lamellae bounding the deep delthyrial cavity. Dorsal valve with 2 extremely short, closely mounted crural bases each side of the dorsal umbo. Cardinal process apparently absent. Musculature obscure.

MEASUREMENTS: M.3472, l. = 9 mm, w. = 10 mm, h. = 5 mm.

Type and Figured Specimens: Holotype M.3472, Loc. 49; M. 3473, Loc. 47, Boola Beds; M.3462, Loc. 36, Conglomerate Phase.

Occurrence: Loc. 36 (rare), Conglomerate Phase, Coopers Creek Formation; Loc. 43 (rare), 49 (occasional), Boola Beds.

Remarks: Talent (1956b) recognized 4 species in a collection of a dozen or so specimens of *Howellella* from the Toongabbie limestones which are of a similar horizon to that of the Coopers Creek Formation. I would consider that only 2 species are present in the Toongabbie collection—the first represented by *Howellella lirata* Talent and *H. latisulcata* Talent, the second by Talent's *Howellella* cf. *H.* (?) *gibbosa* (Barrande) and his *Howellella* sp. indet. This second species is probably *D.* (*H.*) *scabra*, although no direct comparison has been made between the Tyers and Toongabbie specimens, and the Toongabbie forms are not figured. *Spirifer gibbosus* Barrande is apparently a species of *Delthyris S.S.*, although Havlíček (1959) has proposed a new genus *Ivanothyris* for its reception.

D. (*H.*) *scabra* is perhaps closest to *D.* (*H.*) *vauxemi* (Hall) (Howell 1947, Pl. 1, fig. 1-9), although this species may bear more lateral plications and also possesses a faint plication in the sulcus. The Bohemian species described by Barrande (1879) with which *D.* (*H.*) *scabra* may be compared on the basis of external morphology (e.g. *Spirifer insocius*) are placed in different genera by Havlíček (1959).

The feature which distinguishes *Delthyris* from *Howellella*, the presence of a median septum in the dorsal valve, does not appear to be a very stable feature in spiriferids (*fide* Boucot 1957) so here *Howellella* is regarded as a subgenus of *Delthyris*. On the other hand Havlíček (1959), in his classification of spirifers, has separated the two groups at the subfamily level, as he places *Howellella* in the Hysterolitinae. Another genus which appears out of place in that subfamily is *Spinella* Talent 1956, which clearly should be placed near the genus *Spinocyrtia*.

D. (*H.*) *scabra* appears to be a variable species in the number of lateral plications. 4 may be seen on the flanks of the ventral valve of the holotype, although the outer one is very poorly defined. In general, however, 3 are present on the flanks of the ventral valve and 2 on the flanks of the dorsal valve.

Superfamily Rostrospiracea Schuchert & Le Vene

Family Meristellidae Hall & Clarke

Genus **Meristella** Hall 1860

Meristella sp. indet.

(Pl. XXXV, fig. 3)

Description: Ventral valve longitudinally oval in outline with moderately convex lateral profile. Hinge line very short with rounded cardinal extremities. Surface with obscure growth lines. Ventral interior with 2 short dental lamellae bounding the deep delthyrial cavity. A small triangular muscle platform is present about one-third of the distance to the anterior commissure. The ventral valve has a length of 4 mm and a width of 3 mm.

Figured Specimen and Occurrence: M.3488, Loc. 43, Boola Beds.

Remarks: The single small ventral valve clearly represents a species of *Meristella*, but identification at a specific level is not possible.

Family NUCLEOSPIRIDAE Davidson

Genus **Nucleospira** Hall 1857

Nucleospira sp.

(Pl. XXXV, fig. 1)

? *Nucleospira* cf. *marginata* Maurer, Gill 1942, p. 43-4, Pl. 4, fig. 5; Pl. 5, fig. 6.

DESCRIPTION:

EXTERIOR—Ventral valve transversely oval in outline and gently concave in profile. Hinge line short with a fairly prominent umbo. A faint sulcus is present in the ventral valve so the anterior commissure is gently sulcate. Surface poorly preserved and with only irregularly spaced growth lines visible.

VENTRAL INTERIOR—Two strong teeth are mounted each side of the shallow delthyrial cavity. A long straight median septum arises from just anterior of the umbo and extends almost to the commissure, although it is poorly defined for the anterior half of its length. Musculature obscure.

Dorsal valve unknown.

MEASUREMENTS: M.3477, l. = 7 mm, w. = 8 mm.

FIGURED SPECIMEN: M.3477, Loc. 43, Boola Beds.

OCCURRENCE: Loc. 43 (rare), 47 (rare), Boola Beds.

REMARKS: This small species of *Nucleospira* appears to be closely comparable to the Yeringian form identified as *N.* cf. *marginata* Maurer by Gill (1942). A similar form from the Lyell Highway, Tasmania, was named *N. megalorhyncha* by Gill (1948, p. 62, Pl. 8, fig. 27-28, 42-43). Without further material more positive identification of the Tyers form is not possible.

PHYLUM MOLLUSCA

Class LAMELLIBRANCHIATA

Family LEIOPTERIIDAE Maillieux

Genus **Actinopteria** Hall 1883

Actinopteria sp.

(Pl. XXIX, fig. 12)

DESCRIPTION: Small, obliquely pterinoid left valve, with body of shell more strongly differentiated from the posterior wing than from the small anterior wing. Anterior wing much more rounded than posterior wing; hinge line straight, with umbo well toward the anterior. Umbo slightly incurved over the hinge line and directed forward. Body of shell inflated, making an angle of about 35° to the hinge line. Ligament area very thin, extending the length of the hinge line. One thin, slightly oblique posterior lateral tooth extending to well down the posterior wing, obscured by matrix near the umbo.

Surface ornament of strong radial ribs which on the posterior part of the body of the shell are approximately 0·3 mm apart, with their interspaces about one-quarter their diameter. On the posterior wing the radial ribs are closer and less strongly developed, about 0·2 mm apart. Radial ornament crossed by strong, evenly spaced growth lamellae approximately 0·15 mm apart, giving a markedly reticulate appearance to the shell. Where the two sets of ornament intersect there is a tendency for nodes to develop.

Right valve unknown.

MEASUREMENTS: Length along hinge 9 mm, maximum height 6 mm.

FIGURED SPECIMEN: M.3414, Loc. 36, Coopers Creek Formation.

OCCURRENCE: Loc. 36 (rare), Conglomerate Phase, Coopers Creek Formation; Loc. 47 (rare), Boola Beds.

REMARKS: The strongly reticulate ornament of this form is very similar to that of species of *Asselberghsia* Maillieux 1931. However, the internal characters, as far as they can be assessed, are in complete agreement with *Actinopteria*.

The very oblique body chamber in the specimen illustrated appears to have been accentuated by shearing of the enclosing rock.

Family NUCULIDAE Adams

Genus **Nuculites** Conrad 1841

Nuculites sp.

(Pl. XXIX, fig. 9-10)

DESCRIPTION: Left valve small, well rounded and inflated, umbo slightly toward the anterior, directed forward, not prominent; valve with greatest height directly beneath the umbo. A well marked partition extends from just anterior of the umbo to about two-thirds the distance to the ventral margin. This partition is curved with the convex surface to the anterior. Dentition and musculature unknown. Surface marked by a few, ill-defined growth ridges.

MEASUREMENTS: Maximum length 5 mm, maximum height 4 mm.

FIGURED SPECIMEN AND OCCURRENCE: M.3397 A-B from Loc. 43, Boola Beds.

REMARKS: This form is represented in the collection by a single left valve, preserved as an internal and external mould. The strongly curved character of the anterior partition separates this form from other Victorian species of *Nuculites*.

Family CTENODONTIDAE Dall

Genus **Ctenodonta** Salter 1851

Ctenodonta (Ctenodonta) sp. affin. **C. melbournensis** (Chapman)

Affin. *Nuculana melbournensis* Chapman 1908, p. 28, Fig. 29-31.

DESCRIPTION: Small, ovate, biconvex shells with umbos fairly prominent; anterior end distinctly shorter than posterior. Umbos incurved over hinge line and pointing slightly forward. Greatest height of valves directly below the umbos. Dentition of numerous taxodont teeth which pass without interruption beneath the umbo; from the posterior end of the hinge line they decrease greatly in size to beneath the umbo. About 13 teeth posterior to the umbo but apparently very few anterior to it. Muscle scars not apparent. Surface covered by fine, irregularly spaced, growth lines.

MEASUREMENTS: Left valve length 5·5 mm, height 4 mm.

OCCURRENCE: Loc. 43, Boola Beds (rare).

REMARKS: The present species is but half the size of Chapman's species from the Melbourne Beds, but the description could be based on immature specimens.

Subgenus **Praectenodonta** subgenus nov.

(= *Tancrediopsis* Beushausen *sensu* McLearn 1924)

Diagnosis: Rostrate forms with taxodont dentition and surface ornament of broadly spaced, strong growth lamellae.

Type Species: *Palaeoneilo raricostae* Chapman 1908, p. 34-5, Pl. 3, fig. 50; Gill 1949, Pl. 3, fig. 11, and described below.

Remarks: McLearn (1924) has placed the three closely related Victorian species *Palaeoneilo victoriae, P. spectabilis* and *P. raricostae* in the genus *Tancrediopsis* Beushausen 1895, originally proposed as a subgenus of *Ctenodonta* Salter. This change in generic position was accepted without comment by Gill (1949) for *P. raricostae*. As type of the genus McLearn designated *Ctenodonta* (*Tancrediopsis*) *subcontracta* Beushausen. This designation, however, proves to be invalid as Beushausen (1895, p. 70) clearly states as types *Ctenodonta contracta* Salter and *C. sulcata Hisinger*, both fairly typical species of *Ctenodonta* approaching closely *Ctenodonta nasuta* (Hall), the generally accepted type species of the genus. Thus *Tancrediopsis* Beushausen may be regarded as a synonym of *Ctenodonta* Salter (e.g. Maillieux 1936).

Even with *Ctenodonta* (*Tancrediopsis*) *subcontracta* Beushausen as type of the genus it is extremely doubtful if it can be used in the sense of McLearn. When McLearn placed the Victorian species in *Tancrediopsis*, the dentition beneath the umbos was unknown in all three species, so that solely on the basis of their shape and ornament they were better left in the genus *Palaeoneilo* Hall. Specimens of *P. raricostae* are now available which show the dentition. This consists of a row of taxodont teeth which pass without interruption beneath the umbos, and thus the closely related Victorian forms must be placed with *Ctenodonta*. The rostrate shape and ornament of strong growth lamellae, however, precludes their placement in *Ctenodonta S.S.*, so a new subgenus is proposed for their reception. For completeness a description of the type species *P. raricostae* Chapman is given below.

The three species described by McLearn in *Tancrediopsis* cannot with certainty be placed in *Praectenodonta* as their dentition beneath the umbos is unknown. Their general appearance, however, strongly suggests inclusion in the subgenus. *Praectenodonta* thus is known from the Upper Silurian and Lower Devonian of Victoria, doubtfully from the Silurian of Canada, and perhaps even from the Upper Silurian of Scotland in '*Palaeoneilo* cf. *victoriae* Chapman' of Lamont (1948).

In passing it may be noted that *Ctenodonta* Salter 1851 is a junior synonym of *Tellinomya* Hall 1847. This issue is discussed in detail by Williams and Breger (1916, p. 156 *et seq.*). The name *Ctenodonta* is used here, as has been the practice of most authors this century.

Description of **P. raricostae** Chapman

Ctenodonta (Praectenodonta) raricostae (Chapman)

(Pl. XXIX, fig. 11, 13-15, 17)

Palaeoneilo raricostae Chapman 1908, p. 34-5, Pl. 3, fig. 50.
Tancrediopsis raricostae (Chapman) McLearn 1924, p. 100; Gill 1949, Pl. 3, fig. 11.
? *Tancrediopsis raricostae* (Chapman) Gill 1949, p. 109-10, Pl. 2, fig. 4; Pl. 3, fig. 5, 8.

Description: Medium sized, biconvex, rostrate shells, with length more than twice the height. Umbos prominent, half-way along the shell, incurved over the hinge line. Anterior margin well rounded, dorsal margin straight, with shell tapering posteriorly to the subangular posterior margin. Shallow sinus present extending from behind the umbos to posterior margin. Surface covered by broadly spaced, concentric lamellae which become progressively further apart away from the umbo. In the interspaces between the lamellae are present fine growth lirae about 10 of which are present in the larger interspaces. In a shell 28 mm long the strong growth lamellae are less than 0·2 mm apart near the umbo, while marginally they are greater than 0·6 mm apart. Ligament area and musculature not apparent.

Hinge plate widest toward its extremities, contracted beneath the umbos, covered by an uninterrupted row of taxodont teeth, which are larger and further spaced away from the umbo (about 0·4 mm apart) ; passing beneath the umbo they become smaller and closer together till they are less than 0·1 mm apart. Usually about 15 teeth visible each side of the umbo.

Figured Specimens and Occurrence: This species is widely distributed through the Yering Beds. The holotype (P. 7918), from Simmons Bridge, has been illustrated by Gill (1949, Pl. 3, fig. 11). Figured here are P. 17418 from Killara Tunnel and P. 17419-20 from Syme's Homestead, from the Yering Beds.

Remarks: In the orientation of this species the narrower, more contracted end of the shell is regarded as the posterior, following Wilson's (1956) discussion of the orientation of related forms.

The attitude of the valves in the specimen illustrated in Pl. XXIX, fig. 17 suggests that the species possessed an external ligament posterior to the umbos.

Ctenodonta (Praectenodonta) victoriae (Chapman)

(Pl. XXIX, fig. 16)

Palaeoneilo victoriae Chapman 1908b, p. 33, Pl. 3, fig. 46-9.
Tancrediopsis victoriae (Chapman), McLearn 1924, p. 100.

Description: Moderate sized, biconvex, rostrate shells, with prominent umbos apparently incurved over the hinge line. Anterior end well rounded with the shell tapering posteriorly to the subangular posterior margin. A shallow sinus extends from immediately posterior of the umbos to the posterior margin. A narrow platform extends from just posterior of the umbos well down the posterio-dorsal margin; this could represent an external ligament area. Surface with comparatively close growth lamellae, in the interspaces of which there may be up to four fine growth lirae.

Internal features not preserved.

Figured Specimen: M.3398, Loc. 43, Boola Beds.

Occurrence: Loc. 43 (occasional), 45 (rare), 48 (rare), Boola Beds.

Remarks: This species is characteristic of the Melbourne Beds, although Gill (1940, p. 254) records it from Ruddock's Quarry and Hull Rd, within the Yering Beds. It differs from *C.* (*P.*) *raricostae* in its smaller size and much more closely spaced growth lamellae.

Family Pleurophoridae Dall

Genus **Cypricardinia** Hall 1859

Cypricardinia sp.

(Pl. XXXIV, fig. 1-3)

A few valves of a species of *Cypricardinia* were collected from Loc. 47 in the Boola Beds. The surface ornament of this form, in which traces of subradial striations arranged in a chevron pattern are present between the growth lamellae, suggests that it belongs to the group of *Cypricardinia contexta* Barrande, but more material is necessary before positive identification can be made.

PHYLUM ARTHROPODA

Class TRILOBITA

Family CHEIRURIDAE Salter

Genus **Cheirurus** Beyrich 1845

Subgenus **Cheirurus** Beyrich

Cheirurus (Cheirurus) sp.

(Pl. XXXV, fig. 5)

DESCRIPTION: Cranidium wider than long with the fixed cheeks almost twice the width of the occipital ring. Glabella expanding forwards, with the frontal lobe rounded and tumid, about two-thirds as long as wide, and delineated posteriorly by 2 strong, slightly backward directed lateral glabellar furrows. These are strongly incised for over three-quarters of the way to the axis of the glabella and are continued across the axis as a gentle furrow. The second lateral glabellar furrows are similar to the first. Pre-occipital furrow curved backwards and extending about two-thirds of the distance to the axis. Occipital furrow similar in length to the pre-occipital furrow, but with a slight anterior inflection medianly. The median ends of the occipital and pre-occipital furrows delimit a subquadrate depression across the glabella. The pre-occipital lobes each bear a small tubercle towards their axial margins. Occipital ring short, poorly defined across the median part of the glabella, and bearing a low median tubercle. Glabella smooth apart from the tubercles mentioned. Fixed cheeks wide, posteriorly bounded by a narrow border which joins the wider lateral border. Facial suture proparian, with the anterior branch arising from each side of the widest part of the frontal glabellar lobes, extending back close to the glabella, with the lateral branch with a slight forward inclination. Palpebral lobes well developed, continuous with low eye ridges. Fixed cheeks strongly pitted, with the pitting markedly coarser laterally. Glabella without an anterior margin.

FIGURED SPECIMEN AND OCCURRENCE: M.3481, Loc. 55, Boola Beds.

REMARKS: This single large cranidium is clearly referrable to *Cheirurus S.S.* on the basis of the wide fixed cheeks, and the discontinuity of the lateral glabellar furrows across the glabella. It appears to represent a new species characterized by its large size, the complete absence of any anterior border in front of the glabella, and the well developed palpebral lobes. In the general plan of the cranidium it perhaps resembles most closely *C. quenstedti* Barrande (Prantl and Přibyl 1947, Pl. 1, fig. 1) from the Silurian of Bohemia. The single large specimen was collected by Dr D. E. Thomas during a brief visit to the area.

Cheirurus S.S. has been recorded before in Australia in the glabella identified as such by Gill (1948, p. 67, Pl. 8, fig. 6) from Tasmania.

Subgenus **Crotalocephalus** Salter 1853

Cheirurus (Crotalocephalus) silverdalensis Etheridge and Mitchell

(Pl. XXXIV, fig. 1; Pl. XXXV, fig. 1-2, 14, 15)

Crotalocephalus silverdalensis Etheridge and Mitchell 1917, p. 490-1, Pl. 24, fig. 10; Pl. 25, fig. 1-3, 9.

DESCRIPTION: Glabella about twice as long as wide with an expanded tumid frontal lobe. First and second lateral glabellar furrows similar, deeply incised, with a slight backward inclination, and shallowing slightly across the axis. Pre-occipital furrow slightly curved, backwardly directed at an angle of about 60° to the midline of the glabella. Occipital furrow transverse to the glabella marginally but towards the axis it has a sharp forward inflection. Occipital ring fairly long and expanded anteriorly in the median part of the glabella; median tubercle very small. Surface of the glabella with very small well spaced granules. Fixed cheeks fragmentary, covered with coarse pits.

Hyperstome elongate with a well-delineated, domed median body which narrows posteriorly. Border furrow deep with posterior border wide and flat. Anterior wings high and lateral maculae located well to the posterior of the median body. Surface smooth.

Pygidium wide and short with 3 well defined axial rings and a smaller posterior raised area. Pleural ridges well defined toward the axis with the anterior 2 pairs originating opposite the central axial ring, while the posterior pair are opposite the posterior axial ring, are very much smaller and have a strong backward inclination. There are 6 flat tapering marginal spines, the axial pair of which is small and close together, while the outer pair is also reduced in size.

FIGURED SPECIMENS: M.3477, 9, Loc. 43; M.3463, Loc. 47, Boola Beds.

OCCURRENCE: Loc. 43 (occasional), 47 (rare), 48 (rare), 49 (rare), Boola Beds.

REMARKS: In the details of the glabella the Tyers form agrees very well with *C. (C.) silverdalensis* from the Silurian of Yass, N.S.W. Thus the pre-occipital furrows have a stronger backward inclination whereas the occipital furrows are more transverse than in such species as *C. (C.) sternbergi* Boeck. Etheridge and

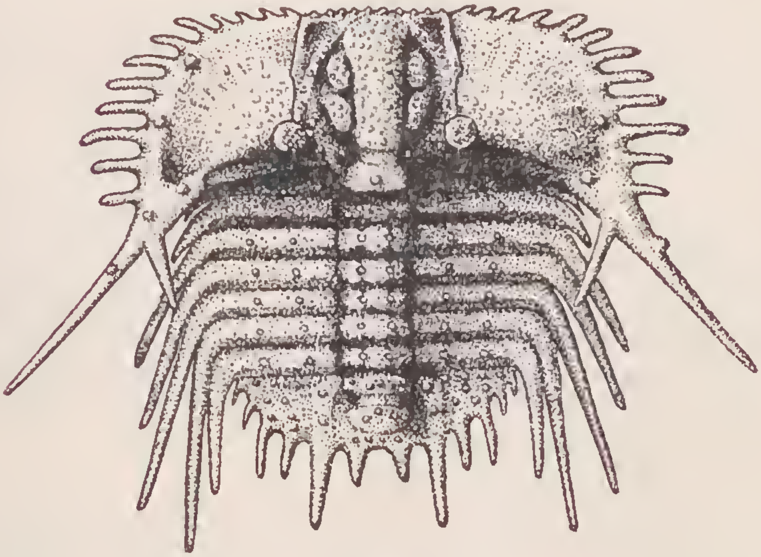

FIG. 17—Reconstruction of *Leonaspis bispinosa* sp. nov. The number and arrangement of thoracic segments is based on *L. williamsi* Whittington. x 3 approx.

Mitchell describe the single poorly preserved pygidium they place in their species as possessing 'centrally a short, flat, rounded spine'. Either they misinterpreted the specimen or the form referred to does not belong to *Crotalocephalus*. It may be noted that in the pygidium from Tyers the marginal spines are less broad and hook-like than is normal for the subgenus.

Family ODONTOPLEURIDAE Burmeister

Genus **Leonaspis** Richter and Richter 1917

Leonaspis bispinosa sp. nov.

(Pl. XXI, fig. 1; Pl. XXXV, fig. 6-13; Fig. 17)

DIAGNOSIS: *Leonaspis* with one strong inwardly and upwardly directed spine mounted well down the labrigenal spine.

DESCRIPTION: Cranidium with a convex occipital ring mounted on which is a comparatively small median tubercle; occipital furrow broad and smooth. Median glabellar lobe widening anteriorly, expanding to reach its maximum diameter at the end of the basal glabellar furrows, and with a rounded anterior margin. 2 pairs of longitudinally ovate lateral glabellar lobes, the anterior pair of which are the more tumid; separated from the median glabellar lobe by the deep basal glabellar furrows. The lower posterior pair are separated from the anterior pair by a lateral glabellar furrow. The well developed eye ridges arise opposite the point of maximum width of the median glabellar lobe and curve backwards apparently obliquely intersecting the facial suture. Frontal branch of facial suture convex outwards. Between the eye ridge and the facial suture is a triangular area of the fixed cheek, bearing a furrow which deepens anteriorly. There is a corresponding triangular area between the eye ridge and the glabella. Posterior branch of facial suture convex forwards, subparallel to the narrow posterior border, across which it curves just inside the genal angle. Palpebral region arched so as to overhang the posterior border. Anterior border short, rising anteriorly, bearing about 10 small spines just inside the straight transverse anterior margin. Surface with fine, closely spaced tubercles on the occipital ring, glabellar lobes and eye ridges. The area of the fixed cheek between the eye ridge and the glabella bears coarser, more distant tubercles, with one large tubercle immediately to each side of the occipital furrow.

Free cheeks triangular, convex, particularly in the eye region, with gently rounded lateral outline and a poorly defined lateral border which becomes wider posteriorly and merges with the broad base of the labrigenal spine. A series of somewhat blunt and flattened, occasionally curved, border spines is mounted along the outer margin of the free cheek. These are usually 12 in number, and gradually increase in size posteriorly, the third last in general being the longest as the last two tend to be reduced in size. A single stout upwardly and posteriorly directed spine is mounted on the inner edge of the labrigenal spine. Labrigenal spine long, flattened, tapering and bearing coarse, widely spaced tubercles on both surfaces. Upper surface of free cheek with low tubercles which become much more closely spaced around the eye. Eye almost stalked, with pyramidal upper surface; eye facets small, arranged in diagonal series.

Thoracic segments with well developed, strongly convex axial rings. Pleurae with a broad median ridge which is projected posteriorly as a long spine. Ornament of 2 tubercles on each side of the axial ring, and another pair on the plural ridges each side of the axial ring, but this appears to vary. Number of thoracic segments unknown.

Pygidium with 2 well separated, strongly convex axial rings. Pleural region with a low raised ridge running transversely from the first axial ring and swinging sharply to the posterior to one of the major marginal spines. Usually a pair of coarse tubercles is mounted on this pleural ridge, but otherwise the surface is irregularly tuberculate. 12 lateral border spines are present, the anterior 2 pairs of which are strongly reduced. The remainder, apart from the 2 major spines, extend approximately the same distance posteriorly, although the lateral spines are thinner.

TYPE AND FIGURED SPECIMENS: Holotype M.3483; M.3482, 4-6, Loc. 43, Boola Beds.

OCCURRENCE: Loc. 40 (rare), 43 (common), 47 (rare), Boola Beds.

REMARKS: This species clearly differs from the other Australian species of *Leonaspis* such as *L. rattei* (Eth. and Mitch.), *L. parvissima* (E. and M.) and *L. hartleii* (Mitchell) in possessing the strong inwardly directed spine on the labrigenal spine. This feature also serves to distinguish *L. bispinosa* from overseas species.

Family CALYMENIDAE Burmeister

Genus **Gravicalymene** Shirley 1936

Gravicalymene angustior (Chapman)

(Pl. XXXV, fig. 16-17)

Calymene angustior Chapman 1915, p. 164-6, Pl. 15, fig. 8-10.
? *Calymene australis* Etheridge and Mitchell 1917, p. 481-6, Pl. 24, fig. 1-3, 6-7, ? 9; ? Pl. 27, fig. 1.
Calymene (*Gravicalymene*) ? *angustior* Chapman, Shirley 1938, p. 487, Pl. 44, fig. 17.
Gravicalymene angustior (Chapman) Gill 1942, p. 45; Gill 1945b, p. 176-9, Pl. 7, fig. 5, 10.
? *Gravicalymene australis* (Etheridge and Mitchell) Gill 1948, p. 69-71, Pl. 8, fig. 9-12.

DESCRIPTION: Cranidium about twice as wide as long, with a comparatively narrow tumid bell-shaped glabella, with 4 lateral glabellar lobes on each side, the anterior 2 of which are poorly defined. Occipital ring wide, well delineated by a deep occipital furrow. Pre-glabellar field wide with a well-defined anterior border.

Pygidium strongly convex, with a well defined axial region which tapers posteriorly. Axial rings well marked anteriorly, but fading posteriorly, apparently with 6 rings. Pleural regions with 5 'segments' the posterior of which is poorly defined; the 4 anterior segments bear furrows towards the margin.

FIGURED SPECIMENS: M.3478, 87, Loc. 47, Boola Beds.

OCCURRENCE: Loc. 43 (rare), 47 (occasional), 49 (rare), Boola Beds.

REMARKS: This form from the Boola Beds appears to be closest to *G. angustior* from the Yering Beds. Gill (1948) has considered that this species is separable from *G. australis*. I am not fully convinced of this, nor, for that matter, that this species and other closely related eastern Australian forms can be strictly placed in the genus *Gravicalymene*. The few specimens from Tyers, however, throw little light on these problems.

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Explanation of Plates

All figures unretouched. All numbers prefixed by 'M' refer to catalogue numbers in the Melbourne University Geology Department Fossil Collection, while those prefixed by 'T' refer to catalogue numbers in the Melbourne University Geology Department Fossil Thin Section and Slide Collection. L.S. and T.S. = longitudinal section and transverse section respectively.

PLATE XI

Fig. 1-2—*Favosites gothlandicus* Lamarck. (1) L.S., T.713; (2) T.S., T.712—both from M.2888, Loc. 11. x 3.

Fig. 3—*Favosites* sp. affin. *F. forbesi* Edwards and Haime. T.784 from M.2925, Loc. 19. x 3.

Fig. 4-5—*Favosites forbesi* Edwards and Haime. (4) T.S., T.723; (5) L.S., T.724—both from M.2892, Loc. 27. x 5.

Fig. 6-9—*Favosites goldfussi* d'Orbigny. (6) T.S., T.764; (7) L.S., T.765—both from M.2916, Loc. 19. x 5; (8) L.S., T.770 from M.2919, Loc. 23. x 10; (9) T.S., T.772 from M.2920, Loc. 5. x 10.

All specimens from Limestone Phase, Coopers Creek Formation.

PLATE XII

All figures x 5.

Fig. 1-2—*Favosites hilloe* sp. nov. (1) L.S., T.789; (2) T.S., T.790—both from holotype M.2927, Loc. 11, Limestone Phase, Coopers Creek Formation.

Fig. 3-4—*Favosites eooetilis* sp. nov. (3) L.S., T.833; (4) T.S., T.834—both from holotype M.2949, Loc. 11, Limestone Phase, Coopers Creek Formation.

Fig. 5-6—*Favosites ollani* Jones. (5) T.S., T. 822; (6) L.S., T.823—both from M.2944, Loc. 27, Limestone Phase, Coopers Creek Formation.

Fig. 7-8—*Favosites moanbiensis* Etheridge. (7) T.S., T.798; (8) L.S., T.800—both from M.2932, Loc. 48, Boola Beds.

Plate XIII

All figures x 5.

Fig. 1-2—*Favosites squamuliferus* Etheridge forma *bryani* Jones. (1) T.S., T891 from M.2973, Loc. 11; (2) L.S., T.917 from M.2982, Loc. 11, Limestone Phase, Coopers Creek Formation

Fig. 3-4—*Favosites* sp. (3) T.S., T.1055; (4) L.S., T.1056—both from M.3009, Loc. 27, Limestone Phase, Coopers Creek Formation.

Fig. 5-6—*Favosites squamuliferus* Etheridge (?). (5) T.S., T.1043; (6) L.S., T.1044—both from M.3007, Loc. 11, Limestone Phase, Coopers Creek Formation. Note the abundant squamulae.

Fig. 7—'*Favosites* (*Emmonsia*) *spinigera*' of Chapman (*non* Hall) T.1203 *ex* Chapman Collection. Deep Creek Limestone.

Fig. 8—'*Emmonsia*' sp. affin. *E. fusta* Greene. L.S., T.1052 from M.3008, Loc. 3, Limestone Phase, Coopers Creek Formation. Corallum attached to a crinoid stem ossicle.

Plate XIV

All figures x 10.

Fig. 1-3—*Favosites hillae* sp. nov. (1) T.S., T.791; (2) T.S., T.790—both from holotype M.2927. Sections illustrating variation in development of septal apparatus and wall thickness. (3) L.S., T.789 from holotype M.2927, Loc. 11.

Fig. 4-6—*Favosites coactilis* sp. nov. (4) T.S., T.834 from holotype M.2949; (5) T.S., T.835 from paratype M.2950. Section of a subdigitate corallum showing the thin-walled axial portion (cf. fig. 4). (6) L.S., T.833 from holotype M.2949. All specimens from Loc. 11.

Fig. 7-8—*Favosites macilentus* sp. nov. (7) T.S., T.850; (8) L.S., T.852—both from holotype M.2956, Loc. 11.

All specimens from Limestone Phase, Coopers Creek Formation.

Plate XV

Fig. 1-2—*Favosites* sp. cf. *F. inosculans* Nicholson. (1) T.S., T.826; (2) L.S., T.827—both from M.2947, Loc. 19. x 10.

Fig. 3-4—*Favosites squamuliferus* Etheridge forma *australis* Chapman. (3) T.S., T.938; (4) L.S., T.937—both from M.2989, Loc. 11. Specimen showing small corallite diameter. x 10.

Fig. 5—*Alveolites* sp. affin. *A. taenioformis* Schlüter L.S., T.917 from M.2982, Loc. 11, Limestone Phase, Coopers Creek Formation. Specimen encrusted by a corallum of *Favosites squamuliferus* forma *bryani*. x 5.

Fig. 6—*Alveolites* sp. T.1062, Loc. 27. x 5.

All specimens from Limestone Phase, Coopers Creek Formation.

Plate XVI

All figures x 5.

Fig. 1, 5—*Notolophyllum callidum* sp. nov. (1) T.1074 from M.3011, holotype, Loc. 20; (5) T.830 from M.2984, Loc. 15—specimen showing sub-pyriform corallum.

Fig. 2-4—*Thamnopora boloniensis* (Gosselet). (2) L.S., T.1067; (3) Tangential section T.1068—both from M.3010. Loc. 11; (4) T.S., T.1073, Loc. 51, Boola Beds.

Fig. 6—*Thamnopora alterivalis* (Chapman). L.S., T.1081, Loc. 27.

All specimens from Limestone Phase, Coopers Creek Formation, unless otherwise stated.

Plate XVII

Fig. 1-4—*Coenites* (*Coenites*) *planifolium* sp. nov. (1) Section cut parallel to the surface of corallum, T.1085, holotype; (2) T.S., T.1091; (3) T.S., T.1088, holotype; (4) T.S., T.1090. All specimens from Loc. 48, Boola Beds. x 5.

Fig. 5-6—*Coenites* (*Cladopora*) *foliata* (Jones). (5) L.S., T.1100; (6) Section parallel to surface of corallum in part T.S. and in part L.S., T.1095. In the middle and upper part of the slide a bryozoan can be seen between two 'branches' of the *Coenites* corallum. Both specimens from Loc. 11, Limestone Phase, Coopers Creek Formation. x 5.

Fig. 7—*Heliolites daintreei* Nicholson and Etheridge. T.S., T.1131, Loc. 11, Limestone Phase, Coopers Creek Formation. x 10.

PLATE XVIII

Fig. 1, 3-7—*Coenites (Clodoporo) gippslandica* (Chapman). (1) T.S., T.1114, Loc. 48, Boola Beds; (3) T.S., T.1109; (4) L.S., T.1110—both from M.3014, Loc. 11, Limestone Phase, Coopers Creek Formation, a large corallum with the thickness of the walls in the axial region accentuated by a layer of secondary calcite; (5) Tangential section T.1112, Loc. 48, Boola Beds. Section showing the shape and districution of the calices at the surface of the corallum; (6) L.S., T.1113; (7) L.S., T.1111—both from Loc. 48, Boola Beds. Illustrated slides chosen to show the variation within the species. x 10.

Fig. 2—*Coenites (Clodopora) foliata* (Jones). T.S., T.1099, Loc. 19, Limestone Phase, Coopers Creek Formation. x 5.

PLATE XIX

All figures x 10.

Fig. 1-4—*Heliolites dointeei* Nicholson and Etheridge. (1) T.S., T.1134; (2) L.S., T.1133 from same specimen, Loc. 20; (3) T.S., T.1135; (4) L.S., T.1136 from same specimen, Loc. 19.

Fig. 5-6—*Plosmoporo gippslondica* (Chapman). (5) T.S., T.1057; (6) L.S., T.1056—both from M.3017, Loc. 5.

All specimens from the Limestone Phase, Coopers Creek Formation.

PLATE XX

Fig. 1-2—*Fossopora quintoria* sp. nov. (1) T.S., T.1124; (2) L.S., T.1125—both from holotype M.3015, Loc. 11. x 10.

Fig. 3-4—*Roemeria thomii* (Chapman). (3) T.S., T.1161; (4) L.S., T.1162—both from M.3013, Loc. 22. x 3 approx.

Fig. 5-6—*Aulopora* sp. affin. *A. emergens* Quenstedt. (5) T.S., T.1166; (6) L.S., T.1167—both from same corallum, Loc. 11. x 10.

All specimens from Limestone Phase, Coopers Creek Formation.

PLATE XXI

All figures x 1 unless otherwise stated.

Fig. 1, 6—*Pleurodictyum megostoma* McCoy. (1) M.3012, Loc. 43, Boola Beds, together with pygidium of *Leonaspis bispinosa* sp. nov.; (6) M.3013, Loc. 36, Conglomerate Phase, Coopers Creek Formation. Specimen showing small corallite diameter. x 2.

Fig. 2—*Coenites (Coenites) plonifolium* sp. nov. M.3044, Loc. 7, Boola Beds; mould of a corallum.

Fig. 3—*Pseudomplexus princeps* (Etheridge) var. *confertus* var. nov. Holotype. M.3024, Loc. 19, Limestone Phase, Coopers Creek Formation; polished transverse section.

Fig. 4—*Favosites moonbiensis* Etheridge. M.2940. Loc. 47, Boola Beds: mould of a corallum.

Fig. 5, 8, 9—*Fovosites forbesi* Edwards and Haime. (5) M.2909, Loc. 49, Boola Beds, mould of a small corallum; (8) M.2931, Loc. 47, Boola Beds; mould of specimen enlarged to show irregularly arranged mural pores and septal spines; lower part of figure shows the sole specimen of *Fovosites squamuliferus* forma *nitidus* collected from the Boola Beds. x 5. (9) M.2926, Loc. 11, Limestone Phase, Coopers Creek Formation; weathered corallum exposed on a limestone slab.

Fig. 7—*Rhizophyllum* (?) sp. M.3042, Loc. 48, Boola Beds.

PLATE XXII

All figures x 2.

Fig. 1-8—*Syringaxon (Soucrophyllum) pocillum* subgenus et sp. nov. (1-6) Serial T.S. from paratype with distance between sections given in mm; (1) T.1193; (2) T.1194—5·4; (3) T.1195—2·4; (4) T.1196—2·6; (5) T.1197—2·5; (6) T.1198—2·5; (7) T.1191, Tangential section showing dissepiments in the interseptal loculi; (8) T.1190, L.S.—both from holotype, M.3021. All specimens from Loc. 50, Boola Beds.

Fig. 9—*Syringaxon (Syringaxon)* sp. T.S., T.1176, Loc. 50, Boola Beds.

Fig. 10—*Springoxon (Borrandeophyllum)* sp. T.1184, Loc. 15, Limestone Phase, Coopers Creek Formation.

Fig. 11-12—*Pseudamplexus princeps* (Etheridge) var. *confertus* var. nov. (11) L.S., T.1514; (12) T.S., T.1513—both from M.3024, holotype, Loc. 19, Limestone Phase, Coopers Creek Formation.

Fig. 13—*Pseudamplexus princeps* (Etheridge). L.S., T.1508, from M.3023, Loc. 19, Limestone Phase, Coopers Creek Formation.

Fig. 14—*Phillipsostrea maculosa* Hill. T.S., T.1519 from M.3026, Loc. 20, Limestone Phase, Coopers Creek Formation.

PLATE XXIII

All figures x 2.

Fig. 1, 5—*Heliophyllum* sp. affin. *H. pinguiseptatum* Hill. (1) L.S., T. 1518; (5) T.S., T.1517 both from M.3025, Loc 20.

Fig. 2—*Thamnophyllum reclinatum* Hill. T.S., T.1546, Loc. 20.

Fig. 3-4—*Mictophyllum* sp. affin. *M. cresswelli* (Chapman). (3) T.S., T.1543; (4) L.S., T.1544 —both from M.3031, Loc. 17.

All specimens from Limestone Phase, Coopers Creek Formation.

PLATE XXIV

All figures x 2.

Fig. 1, 7—*Disphyllum incongruum* sp. nov. (1) L.S., T.1575; (7) T.S., T.1574—both from holotype M.3034, Loc. 21.

Fig. 2-3—*Disphyllum* (?) sp. (2) T.S., T.1542; (3) L.S., T.1541—from same specimen, Loc. 11.

Fig. 4, 8, 9—*Hexagonaria approximans* (Chapman). (4) L.S., T.1524; (9) T.S., T.1525—both from M.3027, specimen showing carinate septa; (8) T.S., T.1527 from M.3028. All from Loc. 11.

Fig. 5, 10—*Disphyllum cognatum* sp. nov. (5) L.S., T.1537; (10) T.S., T.1536—both from holotype, M.3030, Loc. 19.

Fig. 6—*Phillipsastrea speciosa* Chapman. T.1520, Loc. 15.

All specimens from Limestone Phase, Coopers Creek Formation.

PLATE XXV

Fig. 1-2, 7-10—*Thamnophyllum reclinatum* Hill. (1) T.S., T.1545 from M.3032, Loc. 15; (2) T.S., T.1550; (8) L.S., T.1551—both from same specimen showing corallites with wide peripheral zone of septal dilation, Loc. 20; (7) L.S., T.1547, Loc. 20; (9) T.S., T.1548; (10) L.S., T.1549—both from Loc. 15. All x 4 approx.

Fig. 3-4—*Tipheophyllum ops* sp. nov. (3) T.S., T.1580; (4) L.S., T.1579—both from holotype M.3035, Loc. 15. x 2.

Fig. 5-6—*Tipheophyllum* sp. (5) L.S., T.1588; (6) T.S., T.1589—both from Loc. 15. x 2.

Fig. 11-12—*Trapezophyllum elegantulum* (Dun) (11) T.S., T.1573; (12) L.S., T.1572—both from M.3033, Loc. 7. x 2.

All specimens from Limestone Phase, Coopers Creek Formation.

PLATE XXVI

All figures x 2.

Fig. 1, 6—*Xystriphyllum mitchelli* (Etheridge). (1) L.S., T.1535; (6) T.S., T.1534—both from M.3029, Loc. 11.

Fig. 2-3—*Acanthophyllum aequiseptatum* Hill. (2) L.S., T.1593; (3) T.S., T.1592—both from same specimen, Loc. 3.

Fig. 4-5—*Tabulophyllum* (?) *meridionale* sp. nov. (4) T.S., T.1590; (5) L.S., T.1591—both from holotype, M.3036, Loc. 15.

Fig. 7-8—*Acanthophyllum sweeti* Etheridge. (7) T.S., T.1606; (8) L.S., T.1607—from the same specimen, Loc. 15.

Fig. 9-10—*Acanthophyllum monsfieldense* (Dun)? (9) T.S., T.1597; (10) L.S., T.1596—both from Loc. 3.

Fig. 11-12—*Acanthophyllum mansfieldense* (Dun). (11) L.S., T.1602; (12) T.S., T.1601—both from M.3038, Loc. 20.

All specimens from Limestone Phase, Coopers Creek Formation.

PLATE XXVII

Fig. 1-2—*Acanthophyllum clermontensis* (Etheridge). (1) T.S., T.1599; (2) L.S., T.1600—both from M.3037, Loc. 20, Limestone Phase, Coopers Creek Formation. x 2.

PLATE XXVIII

All figures x 2.

Fig. 1-2—*'Cystiphyllum'* sp. affin. *'C'. australiae* Etheridge. (1) T.S., T.1672; (2) L.S., T.1673 —from the same specimen, Loc. 13, Limestone Phase, Coopers Creek Formation

Fig. 3, 10—*Tryplasma* sp. A. (3) T.S., T.1646, Loc. 15; (10) L.S., T.1647, Loc. 22—both from Limestone Phase, Coopers Creek Formation.

Fig. 4-5—*Tryplasma columnare* Etheridge. (4) L.S., T.1640; (5) T.S., T.1639—from the same specimen, Loc. 5, Limestone Phase, Coopers Creek Formation.

Fig. 6-7—*Lyrielasma subcaespitosum* (Chapman) S.S. (6) T.S., T.1631, showing peripheral increase with a circlet of young corallites arising from the widely lonsdaleoid dissepiments of the parent corallites, Lilydale Limestone; (7) L.S., T.1628, Lilydale Limestone.

Fig. 8-9—*Dahmaphyllum pridianum* sp. nov. (8) L.S., T.1614; (9) T.S., T.1613—both from holotype M.3039, Loc. 13, Limestone Phase, Coopers Creek Formation.

Fig. 11-12—*Lyrielasma subcaespitosum praecursor* subsp. nov. (11) L.S., T.1620; (1) T.S., T.1619—both from holotype M.3040, Loc. 15, Limestone Phase, Coopers Creek Formation.

Fig. 13—*Micraplasma* sp. cf. *M. devonica* Soshkina. L.S., T.1670, Loc. 50, Boola Beds.

PLATE XXIX

All figures x 2 unless otherwise stated.

Fig. 1, 3—*Tryplasma wellingtonensis* Etheridge. (1) T.S., T.1643, Loc. 3; (3) T.S., T.1644, Loc. 21—both from Limestone Phase, Coopers Creek Formation.

Fig. 2, 6—*Tryplasma etheridgei* sp. nov. and *Micrasplasma* sp. cf. *M. devonica* Soshkina. (2) L.S., T.1635; (6) T.S., T.1636—Loc. 50, Boola Beds.

Fig. 4, 8—*Tryplasma etheridgei* sp. nov. (4) L.S., T.1633; (8) T.S.,T.1634—holotype, Loc. 50, Boola Beds. x 5.

Fig. 5, 7—*Tryplasma* sp. B. (5) L.S., T.1649; (7) T.S., T.1648—Loc. 48, Boola Beds.

Fig. 9-10—*Nuculites* sp (9) M.3397A, internal mould of left valve; (10) M.3397B, counterpart, Loc. 43, Boola Beds. x 5 approx.

Fig. 11, 13-15, 17—*Ctenodonta* (*Praectenodonta*) *raricostae* (Chapman) subgen. nov. (11) Enlargement of dentition beneath the umbos of specimen in fig. 17. x 5 approx. (13) Internal mould of right valve P. 17419, Syme's Homestead; (14) Dorsal view of same; (15) Counterpart P. 17420; (17) Both valves showing the uninterrupted row of taxodont teeth beneath the umbos, P. 17418, Killara Tunnel. x 2.

Fig. 12—*Actinopteria* sp. Latex impression of external mould of left valve M.3414, Loc. 36, Conglomerate Phase, Coopers Creek Formation. x 5 approx.

Fig. 16—*C.* (*Praectenodonta*) *victoriae* (Chapman) subgen. nov. External mould M.3398, Loc. 43, Boola Beds. x 2.

Fig. 18—*Conocardium costatum* (Cresswell). Internal mould of both valves, M.3399, Loc. 36, Conglomerate Phase, Coopers Creek Formation. x 2.

Fig. 19—*Straparolus* sp. M.3412, Loc. 43, Boola Beds. x 2.

PLATE XXX

All figures x 2.

Fig. 1-6—*Dolerorthis persculpta* sp. nov. (1) Internal would of dorsal valve M.3414A; (5) Counterpart M.3414B, from Loc. 48, Boola Beds; (2) External mould of holotype M.3146B, a dorsal valve, Loc. 47, Boola Beds; (3) Holotype M.3416A; (4) Latex impression of holotype M.3416A; (6) Internal mould of ventral valve, M.3417, Loc. 47, Boola Beds.

Fig. 7-11—*Onniella* (?) *tyersensis* sp. nov. (7) External mould of a large ventral valve M.3421B; (8) Counterpart M.3421A; (9) Internal mould of dorsal valve M.3422; (10) M.3423; (11) Holotype M.3424, dorsal valve. All from Loc. 43, Boola Beds.

Fig. 12-19—*Tyersella typica* gen. et sp. nov. (12) Posterior view of a dorsal valve showing the high socket ridges, M.3425; (13) Internal mould of dorsal valve, M.3426A, holotype; (14) Latex impression of holotype, M.3426A; (15) Counterpart, M.3426B; (16) Internal mould of a small dorsal valve M.3427; (17) Internal mould of ventral valve M.3428; (18) Oblique view of an internal mould of the ventral muscle area, showing the pedicle callist M.3429; (19) Dorsal and ventral valves, M.3427. All specimens from Loc. 36, Conglomerate Phase, Coopers Creek Formation.

Fig. 20-24—*Resserella impensa* sp. nov. (20) External mould of dorsal valve of holotype, M.3430B; (21) Dorsal view of holotype M.3430A, internal mould of both valves; (22) Ventral view of same, Loc. 49, Boola Beds; (23) Internal mould of ventral valve M.3431; (24) Internal mould of ventral valve M.3432, both from Loc. 36, Conglomerate Phase, Coopers Creek Formation.

Plate XXXI

All figures x 2 unless otherwise stated.

Fig. 1-2—*Schizophoria* sp. indet. (1) Internal mould of dorsal valve, M.3433, Loc. 47, Boola Beds; (2) Internal mould of a fragmentary ventral valve, M.3434, Loc. 49, Boola Beds.

Fig. 3-6—*Isorthis festiva* sp. nov. (3) Internal mould of dorsal valve, M.3435, Loc. 49, Boola Beds; (4) Ventral view of a fragmentary internal mould of both valves, M.3436A, holotype; (5) External mould of dorsal valve of same, M.3436B, Loc. 47, Boola Beds; (6) Internal mould of dorsal valve, M.3437, Loc. 49, Boola Beds.

Fig. 7-8—*'Gypidula' victoriae* Chapman. (7) Internal mould of ventral valve, M.3438A; (8) Counterpart of same, M.3438B.

Fig. 9-10—*Notanoplia australis* (Gill). (9) External mould of ventral valve, M.3439B; (10) Counterpart of same, M.3439A, Loc. 47, Boola Beds. x 5.

Fig. 11-17—*Notanoplia* sp. (11) Internal mould of dorsal valve together with an external mould of *Cladopora* (*Cladopora*) *gippslandica* (Chapman), M.3440, Loc. 36, Conglomerate Phase, Coopers Creek Formation; (12) Two ventral interiors together with an external mould of portion of a valve of *Lissatrypa lenticulata* sp. nov. M.3441; (13) Fragmentary internal moulds of a dorsal and ventral valve, M.3442. x 5; (14) Internal mould of dorsal valve, M.3443. x 5; (15) Internal mould of ventral valve, M.3444. x 5; (16) External mould of dorsal valve. M.3445. x 5; (17) Internal mould of ventral valve, M.3441. x 5.

Fig. 18-19—*Plectodonta bipartita* (Chapman). (18) Internal mould of a small dorsal valve together with a number of external moulds, M.3446, x 5; (19) Internal mould of ventral valve, M.3447. x 5.

All specimens from Loc. 43, Boola Beds, unless otherwise stated.

Plate XXXII

Fig. 1-6, x 2; 7-9, x 5.

Fig. 1—*Leptostrophia* sp. affin. *affinalata* (Gill). Internal mould of ventral valve, M.3448, Loc. 47, Boola Beds.

Fig. 2-3—*Leptostrophia* sp. cf. *L. explanata* (Sowerby). (2) External mould of ventral valve, M.3449B; (3) Latex impression of counterpart M.3449A, Loc. 36, Conglomerate Phase, Coopers Creek Formation.

Fig. 4-5—*Strophonella gippslandica* sp. nov. (4) Latex impression of holotype, M.3450, internal mould of ventral valve; (5) External mould of ventral valve, M.3451, both from Loc. 47, Boola Beds.

Fig. 6—*Megastrophia* (?) sp. Ventral valve, M.3452, Loc. 11, Limestone Phase, Coopers Creek Formation.

Fig. 7-9—*Chonetes cresswelli* Chapman. (7) Internal mould of ventral valve, M.3453; (8) The same, M.3454; (9) The same, M.3455. All from Loc. 43, Boola Beds.

Plate XXXIII

All figures x 2.

Fig. 1-3—*Uncinulus* (?) sp. (1) Dorsal; (2) Anterior; (3) Ventral views of M.3456, Loc. 15, Limestone Phase, Coopers Creek Formation.

Fig. 4-10—*Atrypa* sp. cf. *A. reticularis* (Linnaeus). (4) Ventral; (5) Dorsal; (6) Posterior; (7) Anterior views of M.3457, Loc. 48, Boola Beds; (8) Internal mould of dorsal valve, M.3458, Loc. 48, Boola Beds; (9) Internal mould of ventral valve, M.3433, Loc. 47, Boola Beds; (10) External mould of ventral valve of a specimen with closely spaced ribs, M.3459, Loc. 47, Boola Beds.

Fig. 11—(?) *Leptostrophia* sp. affin. *affinalata* (Gill). Latex impression of internal mould of dorsal valve, M.3460, Loc. 43, Boola Beds.

Fig. 12-13—*Notoleptaena otophera* Gill. (12) Internal mould of ventral valve, M.3461A; (13) Counterpart, M.3461B, Loc. 47, Boola Beds.

Fig. 14-15—*Maoristrophia* sp. (14) Internal mould of ventral valve, M.3462A; (15) Counterpart, M.3462B, Loc. 36, Conglomerate Phase, Coopers Creek Formation.

Plate XXXIV

All figures x 2, except fig. 3, x 5.

Fig. 1-3—*Atrypa fimbriata* Chapman. (1) External mould of ventral valve together with an internal mould of the pygidium of *Cheirurus* (*Crotalocephalus*) *silverdalensis* Etheridge and Mitchell and an external mould of *Cypricardinia* sp. M.3463A; (2) Internal mould of ventral valve M.3463B; (3) Enlargement of portion of fig. 1 showing the surface ornaments of both forms, Loc. 47, Boola Beds.

Fig. 4, 17-21—*Lissatrypa lenticulata* sp. nov. (4) Posterior view of both valves, M.3464; (17) Internal mould of ventral valve, M.3465; (18) Internal mould of ventral valve M.3466; (19) Internal mould of ventral valve, M.3397; (20) Internal mould of dosal valve, M.3467, holotype; (21) Internal mould of dorsal valve, M.3468. All from Loc. 43, Boola Beds.

Fig. 5-9—*Plectatrypa australis* sp. nov. (5) Internal mould of both valves, ventral view, M.3469, Loc. 48, Boola Beds; (6) External mould of ventral valve, M.3470, Loc. 47, Boola Beds; (7) Ventral; (8) Dorsal; (9) Anterior views of holotype, M.3471, Loc. 48, Boola Beds.

Fig. 10-13, 22—*Delthyris* (*Howellella*) *scabra* sp. nov. (10) Ventral; (11) Dorsal; (12) Lateral; (13) Posterior views of holotype, M.3472A, internal mould of both valves, Loc. 49, Boola Beds; (22) External mould of dorsal valve, M.3473, Loc. 47, Boola Beds.

Fig. 14-16—*Eospirifer* sp. affin. *E. togatus* (Barrande). (14) Ventral valve, M.3474, Loc. 48, Boola Beds; (15) Internal mould of ventral valve, M.3475, Loc. 49, Boola Beds; (16) Internal mould of a large ventral valve, M.3476, Loc. 48, Boola Beds.

Plate XXXV

All figures x 2 unless otherwise stated.

Fig. 1—*Nucleospira* sp. Internal mould of ventral valve together with internal mould of hyperstome of *Cheirurus* (*Crotalocephalus*) *silverdalensis* Etheridge and Mitchell and an internal mould of a ventral valve of *Plectodonta bipartita* (Chapman), M.3477A, Loc. 43, Boola Beds.

Fig. 2, 14-15—*Cheirurus* (*Crotalocephalus*) *silverdalensis* Etheridge and Mitchell. (2) External mould of hyperstome, counterpart of fig. 1, M.3477B; (14) Latex impression of external mould of a fragmentary glabella, M.3477; (15) Latex impression of another external mould of a glabella M.3479, all from Loc. 43, Boola Beds.

Fig. 3—*Meristella* sp. Internal mould of ventral valve M.3488, Loc. 43, Boola Beds. x 5.

Fig. 4—Internal mould of portion of an indeterminate cheirurid thorax, M.3480, Loc. 47, Boola Beds.

Fig. 5—*Cheirurus* (*Cheirurus*) sp. Cranidium, M.3481, Loc. 55, Boola Beds.

Fig. 6-13—*Leonaspis bispinosa* sp. nov. (6) Lateral view of internal mould of free cheek, showing eye, M.3482; (7) Latex impression of holotype, a cranidium, M.3483B; (8) Holotype, M.3483B; (9) Internal mould of holotype, M.3483A; (10) Internal mould of pygidium, M.3484; (11, 12) Lateral and ventral views of a latex impression of an external mould of the free cheek, M.3485; (13) Latex impression showing the underside of the free cheek, from M.2486. All specimens from Loc. 43, Boola Beds.

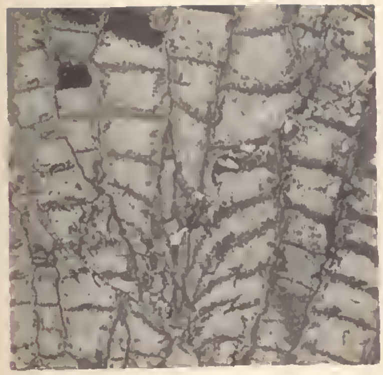
Fig. 16-17—*Gravicalymene angusitor* (Chapman). (16) Internal mould of cranidium, M.3487; (17) Internal mould of pygidium, M.3478, both from Loc. 47, Boola Beds.

Fig. 18—*Delthyris* (*Howellella*) *scabra* sp. nov. External mould of dorsal valve showing the ornament, M.3462, Loc. 36, Conglomerate Phase, Coopers Creek Formation.

Addendum

Throughout the body of the text of this paper, as elsewhere (Philip 1960), the Boola Beds are taken as being of upper Ludlow age and the Coopers Creek Formation is thought to be early Lower Devonian.

The Silurian age of the Boola Beds was established on the brachiopods of the fauna. Particular emphasis was placed on the occurrence of the genera *Dolerorthis, Plectatrypa, Resserella* and *Lissatrypa* (the species of *Onniella* should only questionably be referred to that genus), with such other genera as *Plectodonta, Howellella,*



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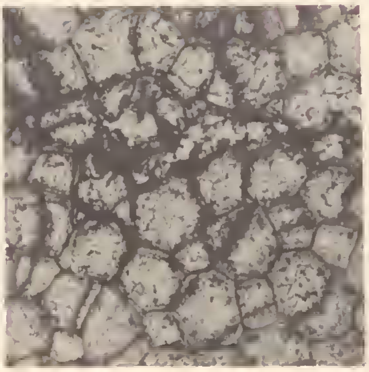

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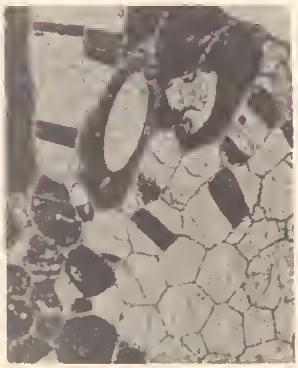

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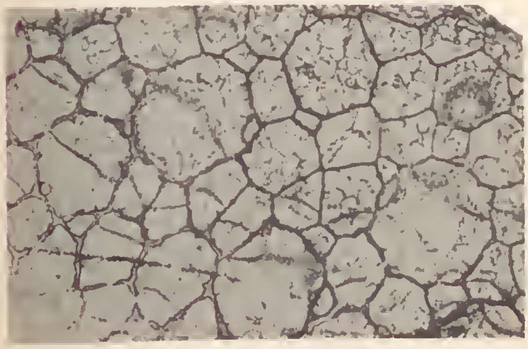

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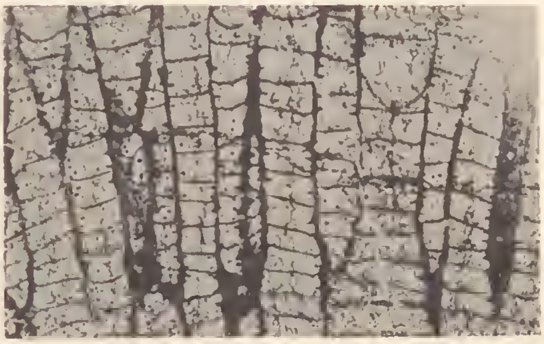

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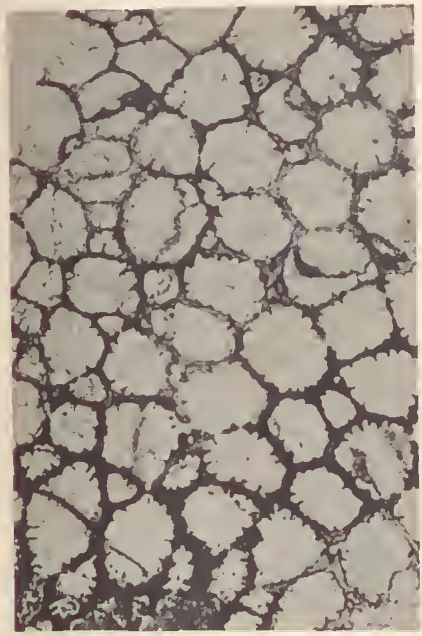

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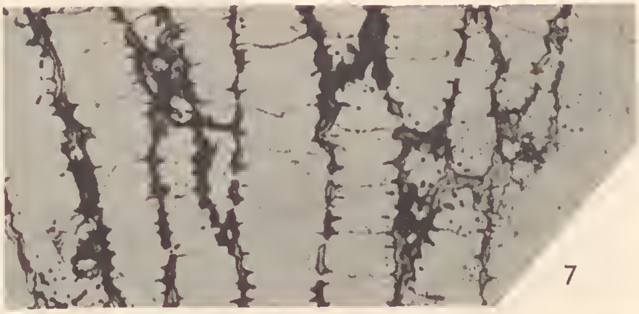

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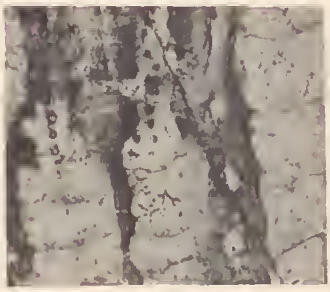

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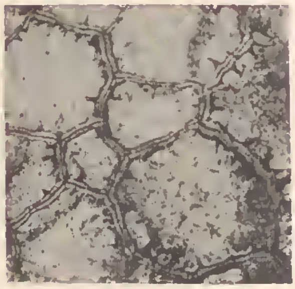

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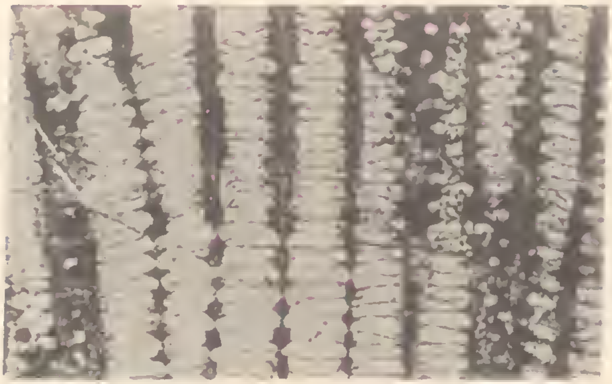

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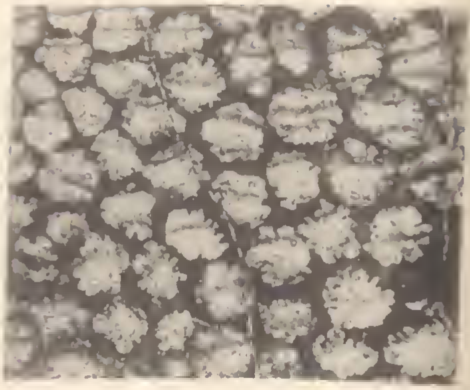

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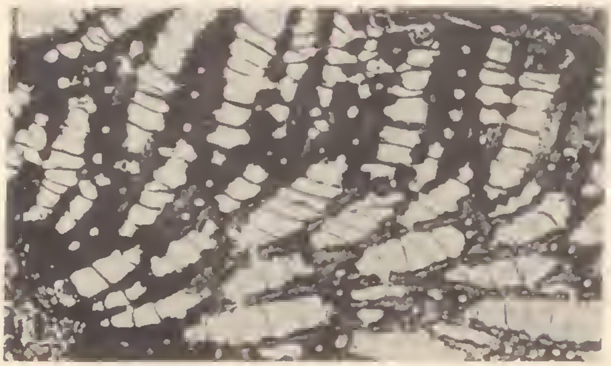

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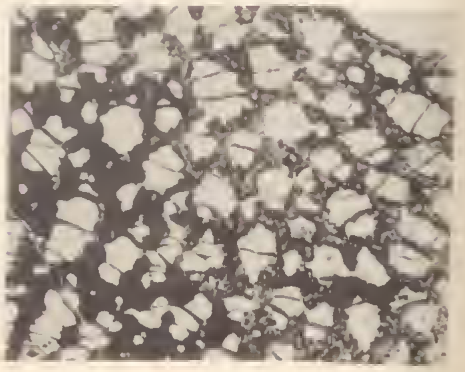

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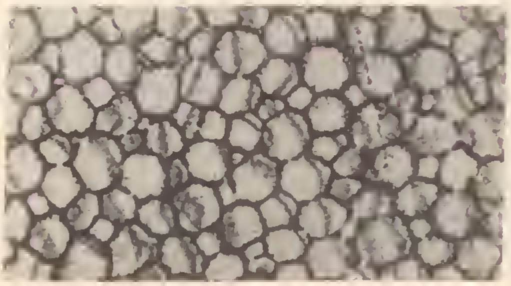

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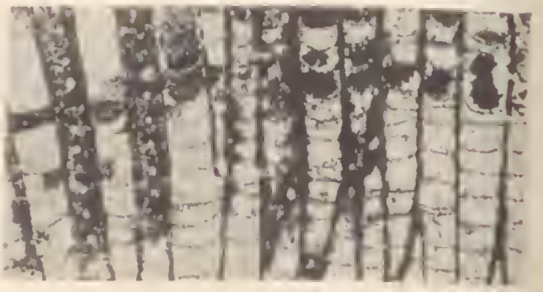

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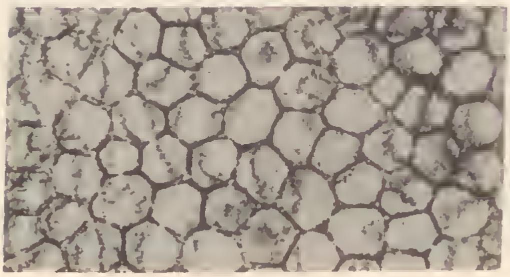

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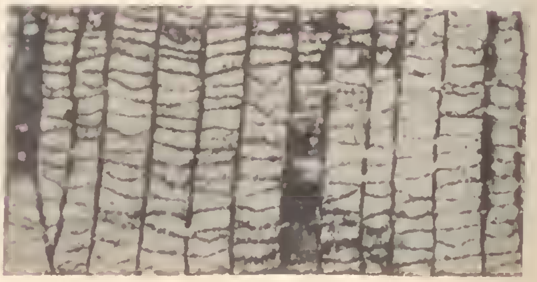

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